

Scottish Health Facilities Note 30: Version 3



Infection control in the built environment: Design and planning



Health Facilities Scotland

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Version 3

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1. Scope

- 1.1 This document is a revision of Scottish Health Facilities Note 30 (SHFN 30): 'Infection Control in the built environment: design and planning' which was published in 2002. The need for a revised document has become increasingly apparent in light of the determined focus being applied to reducing Healthcare Associated Infections (HAIs). This focus has highlighted the need for initial, rigorous examination of proposals for new build healthcare facilities, extensions to healthcare facilities, and refurbishment of healthcare facilities in relation to prevention and control of infection. Having highlighted the need for a rigorous examination of proposals in relation to new healthcare facilities, good practice also requires an ongoing audit of existing healthcare facilities.
- 1.2 SHFN 30 is intended to guide and stimulate thinking on the planning and execution of new construction and refurbishment works in all types of healthcare facilities.
- 1.3 The document is aimed at all those involved in the provision of new or refurbished facilities and aims to ensure that prevention and control of infection issues are identified, analysed and planned for at the earliest stage of a project.
- 1.4 Project team members and contributors from various disciplines will take different points from the document and it is the ensuing debate and analysis which will improve the quality of the delivered facility.
- 1.5 SHFN 30 should also be seen as a reference guide, for use in conjunction with the HAI System for the Control of Risk of Infection in the Built Environment (HAI-SCRIBE), which is concurrently being developed for use within NHSScotland. HAI-SCRIBE aims to reduce infection hazards through the development of a prevention and control of infection questionnaire using a number of scenarios within the built healthcare environment.

These scenarios are:

- the proposed site for development of a healthcare facility;
 - the design and planning stage of the proposed healthcare facility;
 - the construction and refurbishment stage of the healthcare facility;
 - the ongoing maintenance of the healthcare facility.
- 1.6 Although HAI-SCRIBE is intended mainly for new build and refurbishment of healthcare facilities, the question set relating to ongoing maintenance should also be applied to all existing healthcare facilities. Continual maintenance of existing healthcare buildings is important in ensuring that there is no deterioration of existing healthcare facilities. The built environment includes existing buildings used for healthcare purposes and new build projects, and the intention is to apply HAI-SCRIBE from design and planning through to occupation and operation of the facility.

2. Introduction

2.1 In recent years there has been an increase in concern about the risks to health from receiving treatment and care in healthcare facilities. The Report of a Joint Scottish Executive Health Department and NHSScotland Working Group (Carey Group 2001) states that studies have found:

- an estimated 9% of hospital patients acquire an infection during their stay;
- risks are not only present in hospitals but also in primary healthcare and social care settings;
- there is a risk of vCJD, the human form of BSE, being spread from person to person by surgical instruments.

Furthermore, a report by Walker (2001) estimates that the total cost to Scotland of HAI is approximately £186 million per annum.

2.2 Advances in technical and therapeutic methodologies are among the range of factors which present further challenges in relation to control of infection. Organisms with antimicrobial resistance have become a major public health threat, making infection occurring within healthcare premises increasingly difficult to treat. Infection originating in hospitals and other healthcare facilities is now recognised as a serious and widespread problem. Although standards of hygiene in healthcare facilities and standards of personal hygiene have been identified as likely sources of infection and infection spread, it can also be said that the design, planning, construction, refurbishment and ongoing maintenance of the healthcare facility also have an important role to play in the control of infection. The physical environment has to assist, not hinder, good practice.

Origins

2.3 Healthcare Associated Infection (HAI) is a priority issue for NHSScotland. A major programme of work to improve the prevention and control of HAI across NHSScotland was laid out in the Ministerial HAI Action Plan, HDL(2002)82. Under the Chairmanship of the Chief Medical Officer (CMO), the HAI Task Force is now carrying out the programme of work highlighted by the Action Plan. Part of the HAI Task Force 3-year programme of work involves producing guidance on updating the physical environment for older buildings and reviewing the current guidance relating to prevention and control of infection in the built environment; the HAI Task Force Groups 6 & 8 have been charged with undertaking this work. These groups have been combined and are led by Health Facilities Scotland.

Background

2.4 Healthcare Associated Infection (HAI) can be described as infection that is acquired during a visit or is related to a stay in a healthcare facility. In recent years there has been an increase in concern surrounding the risks to health from receiving treatment and care in healthcare facilities. Incidences of HAI are

now recognised as a serious and widespread problem, although the true extent of healthcare associated infection is difficult to quantify.

- 2.5 As part of the national HAI strategy, an HAI prevalence survey will be undertaken to provide data on the overall burden and costs of HAI to Scotland. This survey is being progressed by the HAI Task Force, through Health Protection Scotland (HPS). The Pilot Survey started in May 2005.
- 2.6 HAI is significant medically because of the associated mortality and morbidity. This is highlighted by the fact that approximately 1 in 10 patients acquire an infection as a result of receiving treatment and care in healthcare facilities (Plowman et al, 1999). It is also important economically, with one estimate suggesting that the annual cost to NHSScotland due to HAI may be as high as £186 million with the loss of 380,000 bed days (Walker, 2001). Furthermore, research findings show that at least 20% of HAIs are preventable (Harbarth, 2003). Control of HAI is therefore a major concern, and the high incidence of HAI is seen as evidence of poor quality of healthcare delivery, which leads inevitably to avoidable costs (WHO, 2002). It has been estimated that the compensation cost from clinical negligence resulting in HAI is £4 million per annum and non-conformance with recommendations and guidelines of all kinds accounts for 32% of United Kingdom NHS compensation costs (Wanless, 2001).
- 2.7 The Report of a Joint Scottish Executive Health Department and NHSScotland Working Group in April 2002 states that HAI can affect patients, staff and others in all healthcare settings, not just in hospitals. Potential consequences to health as a result of HAI may be wide ranging including hospital admission, prolonged stay, absence from work, increased costs to the NHS, the individual and/or families, and emotional distress to the latter.
- 2.8 The most common types of HAIs are urinary tract infection, surgical site infection, and lower respiratory tract infections such as pneumonia, which account for an estimated 92% of all HAIs. Figure 1 adapted from Ayliffe (1992) shows the routes of transmission for Healthcare Associated Infections.

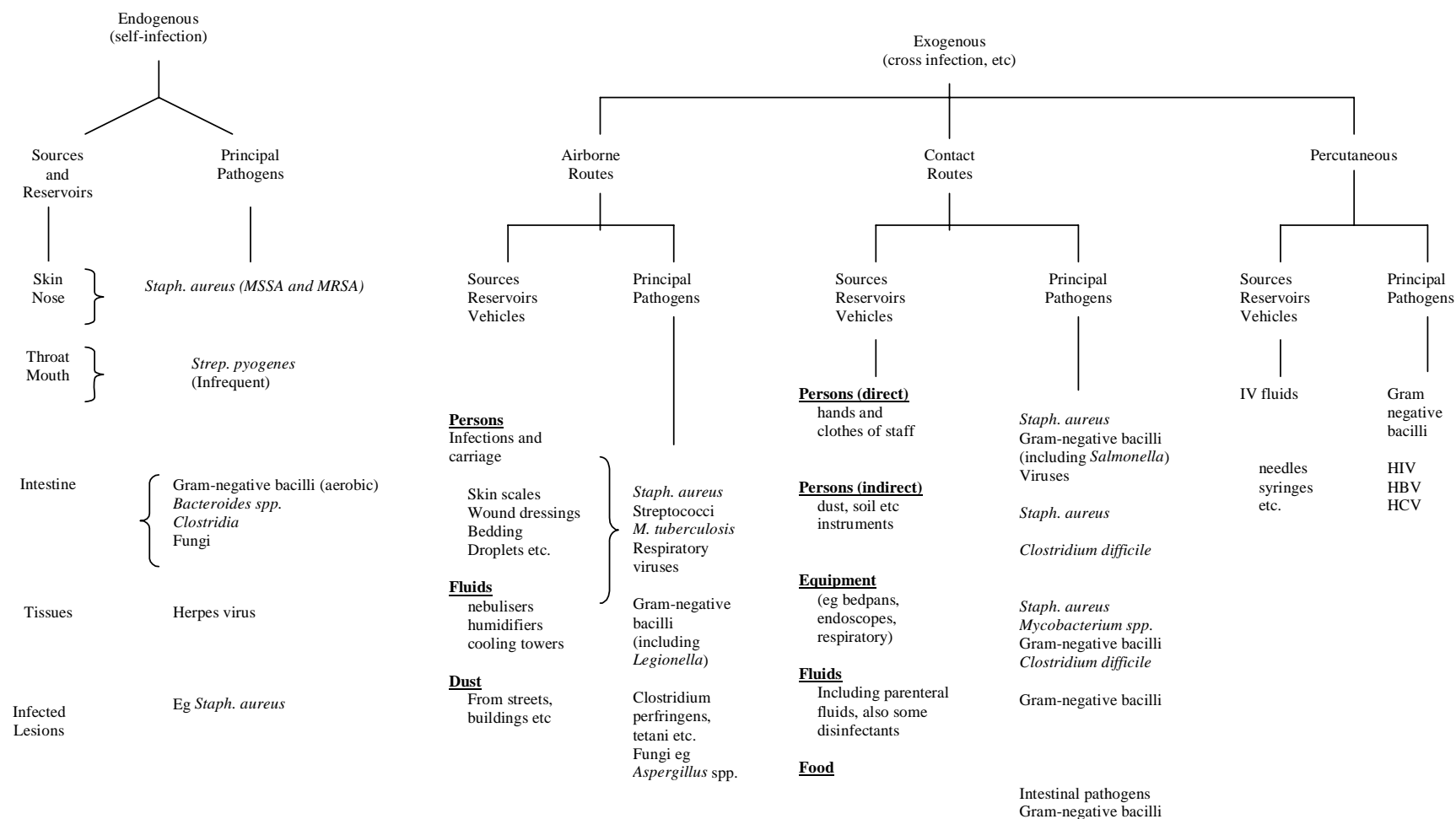


Figure 1: Roots of transmission adapted from Ayliffe (1992)

Purpose of this document

- 2.9 This guidance document should not be seen as being an infection control manual or a comprehensive guide to the principles underpinning the global issues surrounding prevention and control of infection. It should be seen as guidance which highlights the prevention and control of infection issues associated with site development, design and planning, construction and refurbishment and on-going maintenance of the healthcare facility.
- 2.10 The document's principal aim is to provide information on the prevention and control of infection, and on the prevention of cross-infection and cross contamination in healthcare facilities, to those responsible for the planning, design and maintenance of such facilities. It is imperative that those involved in these processes have a sound knowledge of prevention and control of infection in the built environment. This document can provide an insight to the key factors within the built environment which can impact on the control of infection. However, further knowledge may be gained by training in HAI which is available from a variety of sources from basic induction training to specialist post graduate level courses such as 'Controlling the risk from Healthcare Associated Infection in healthcare environments' module which is provided by Glasgow Caledonian University as part of the MSc Healthcare Property and Facilities Management. It is therefore intended as a first point of reference on prevention and control of infection for healthcare estates and facilities managers, architects, builders, engineers, surveyors, health planners and Infection Control Teams working on healthcare estate new build and refurbishment projects. It will also be useful as a guide for best practice in existing healthcare facilities.
- 2.11 Throughout the various sections of the document there are a number of key themes which are repeated. These are:
- Project Team;
 - Importance of education;
 - Risk management;
 - Legislative issues.
- 2.12 These themes are discussed in Sections 3-6 of this document, in order to give an indication of why they are important in relation to the prevention and control of infection within the built healthcare environment.
- 2.13 Sections 7-13 refer to the processes involved in the development and maintenance of the healthcare facility. These sections highlight how the key issues fit into the processes involved in the development and maintenance of the healthcare facility.

The built environment and quality of care

- 2.14 HAI is a complex issue involving the whole patient journey and the many different elements of treatment and care provision, however, it is clear that the built environment plays a key role in the prevention and control of HAI.

- 2.15 Developing solutions to this serious problem requires a clear understanding of how the commissioning, planning, design, procurement, construction and operation and maintenance of healthcare properties can contribute to the prevention and control of HAI. The absence of a holistic approach to the management of these stages of development and maintenance of healthcare facilities may compromise prevention and control of infection. Although there is a need to improve the evidence base in some areas, much of the knowledge surrounding the control of HAI has been published in standards, journals and guidelines. Much of the solution to the existing HAI problem lies in the effective dissemination and implementation of existing knowledge to all involved, in a logical, accessible form.

3. The Project Team

- 3.1 Healthcare Associated Infection (HAI) is a complex issue involving the many different elements of patient care and provision. Due to its multi-factorial nature there is a need to develop a holistic approach to combating the spread of infection within the built environment. To achieve this, knowledge from a wide variety of sources is needed including Infection Control Specialists, Architects, Facilities Managers and Engineers.
- 3.2 A comprehensive approach to planning needs to include consultation with, and participation of, appropriate specialists from its inception through to post-project evaluation.

Management of the Project

- 3.3 The Scottish Executive Health Department's, Scottish Capital Investment Manual (SCIM) sets out the organisational structure of the Project within NHSScotland, a summary of which can be described as follows:

NHS Board internal organisation

- i. **NHS Board** - monitor cost and progress of all capital investment projects at regular meetings. If problems are identified, it needs to be satisfied that appropriate steps are being taken;
- ii. **Chief Executive Officer** – accountable to NHS Board. May be only person with total responsibility for project and any other related activities. Responsible for management of all major capital schemes at all stages of the process from inception to post project evaluation;
- iii. **Project Board** - comprising senior staff within the NHS Board who have an interest in the project and whose activities will be affected by the project, e.g. staff from clinical areas such as infection control;
- iv. **Project Director** - responsible for overall project management. Managing the NHS Boards interest in the Project. Evaluating competence of and appointing Consultants and Contractors who will undertake design and construction activity and act as point of contract in dealings with Contractors;
- v. **Professional Adviser** - experienced in construction and design, especially of healthcare facilities;
- vi. **User Panel** - representatives of each of the relevant service departments, in each case authorised to define their department's needs and to review and agree how those needs are to be met.

External resources:

- i. **Project Manager** – NHS Boards rarely have capacity in-house to develop and manage all aspects of the project, therefore it is usually necessary to appoint external Advisors and Consultants. The Project Manager's role is to provide a single point of responsibility for the project brief and design. They also oversee the day to day progress of the project;
- ii. **Other Consultants** – this includes Design Consultants, M & E Engineers and Architects. They are managed by the Project Manager, appointed by the Project Director. However, their responsibility will be to, and their contracts with, the NHS Board.

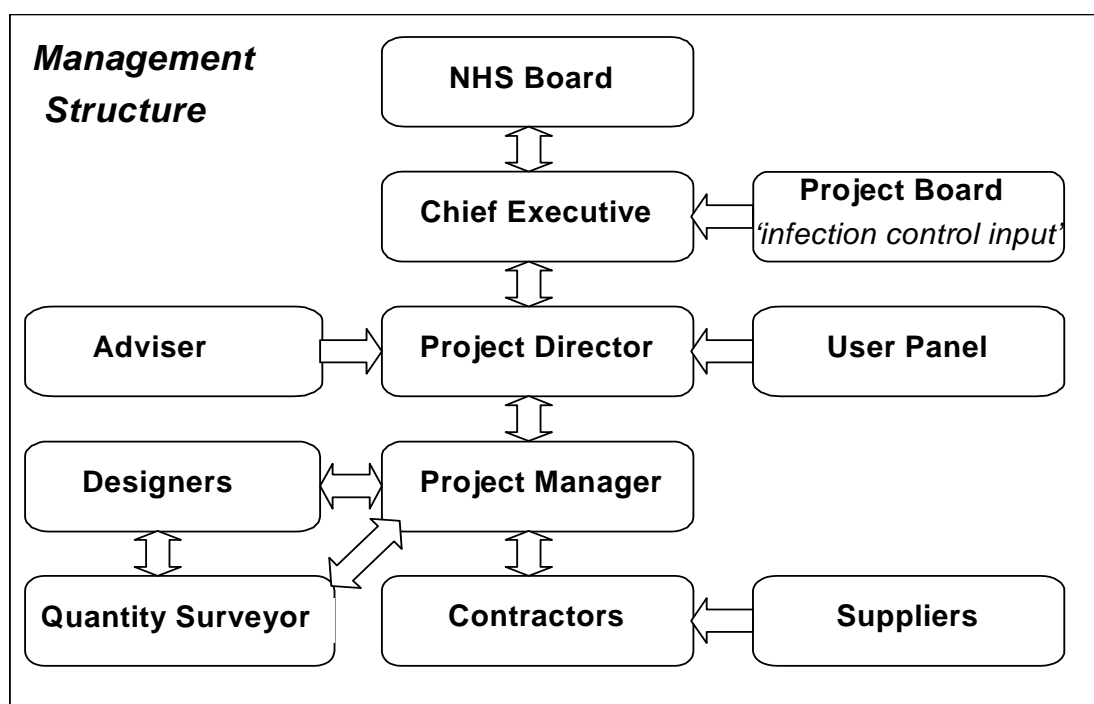


Table 1: Highlighting the management structure of the key players involved in the development of the healthcare facility

Importance of experience and understanding of prevention and control of infection in the Project Team

- 3.4 Due to its multi-factorial nature, knowledge and understanding of HAI is not only necessary for Infection Control Specialists. There is a necessity for all staff involved in the procurement, design, construction and maintenance of the healthcare facility to be appropriately educated in prevention and control of infection. Training on prevention and control of infection of these groups is available from a variety of sources ranging from basic induction training (NHS Education for Scotland's Mandatory HAI Induction Training Framework and NHS Education for Scotland's Cleanliness Champions Programme), to more specialist training at Post-Graduate level.
- 3.5 Prevention and control of Healthcare Associated Infection is significantly increasing in profile within NHSScotland. The Ministerial Action Plan

'Preventing infections acquired while receiving healthcare' HDL(2002)82 sets out an Action Plan which is being undertaken by the HAI Task Force. Within the Action Plan there is reference to the promotion of good prevention and control of infection practice in wards, clinical settings and support services, emphasising that the work environment should be conducive to good prevention and control of infection practice and that environment and equipment standards must be maintained.

- 3.6 There are a variety of measures which contribute to the prevention of infection. However, despite every best effort, not all infections are preventable. Resources must be directed towards minimising the risk where infection can be prevented and facility design plays an important role in achieving this.

Importance of Infection Control input

- 3.7 Any project to build or refurbish healthcare facilities requires the involvement of a multi-disciplinary team from planning to completion and must include input from Infection Control Specialists throughout the project. The importance of a clean, safe environment should not be under-estimated, as it will help ensure that:

- health and safety needs in terms of limiting the risk of infection of the occupants, healthcare workers and building contractors, are met during the project;
- the building design features will minimise the risk of transmission of infection;
- important design issues are considered at the project planning stage to avoid costly modification at a later stage.

- 3.8 Infection Control staff provide expertise and advice on the prevention and control of infection and as such play a pivotal role in ensuring other members of the Project Team are appropriately informed of any prevention and control of infection issues which may arise when:

- an initial site is being considered for development;
- the healthcare facility is being designed;
- the healthcare facility is being constructed or undergoing refurbishment;
- the healthcare facility is operational.

Examples of issues to be considered by the Project Team

- 3.9 Any disturbance of the environment caused by maintenance, demolition, construction and renovation presents a risk of infection to the occupants including:

- exposure to airborne micro-organisms such as *Aspergillus* spp;
- water entry and absorption into building materials leading to increased microbial contamination;

- access for insect pests and vermin;
- increased traffic through the facility;
- dust and debris in patient care areas and local/central decontamination units.

3.10 It is important to consider certain issues before construction work commences including:

- the type and extent of construction or renovation work;
- the likelihood of contamination to adjacent patient care areas;
- the impact on traffic for supplies e.g. sterile stock storage and delivery;
- the air flow and pressure differentials in the area (differentials may be varied by external wind strength and direction);
- the susceptibility of the occupants to infection e.g. through respiratory problems, immuno-compromised or intensive care patients;
- requirements for extra cleaning facilities.

3.11 Suitable efficient barriers may be required for dust control where work is to be carried out near patient areas. Examples of work include:

- demolition of walls, plaster and ceilings;
- removal of flooring, carpets, windows and doors;
- routine maintenance activities;
- any work with water which may aerosolise water droplets in high risk areas;
- exposure of ceiling voids;
- repairing water damage.

3.12 Transmission of micro-organisms with potential to cause infection requires three main elements:

- a susceptible host;
- reservoir of an infectious agent;
- an environment which allows the infection agent to colonise and possibly cause an infection in the susceptible host.

3.13 The risk of infection increases when micro-organisms exist in sufficient numbers in the environment and have the means of transmission to a susceptible host.

3.14 Implementation of effective prevention and control of infection measures reduce the risk of transmission by promoting an environment where risk of interaction between organism and susceptible host is minimised and this can be achieved by:

- proper design and maintenance of ventilation systems;

- designs which minimise accumulation of liquids in the airstream;
- designs which facilitate cleaning and good housekeeping;
- provision, where appropriate, of negative pressure ventilation;
- provision of adequate hand-hygiene facilities;
- provision, where appropriate, of adequate decontamination facilities.

3.15 Standard precautions should be adopted at all times in the healthcare setting but on occasion, additional transmission based precautions such as isolation are required to protect other patients, particularly those who are susceptible, staff and visitors. In any care setting, provision for the following in building design will assist in reducing the risk of infection:

- easy access to hand-hygiene facilities;
- suitable ventilation;
- adequate space for storage and ease of movement for patients and staff;
- surfaces, furnishing and fittings which will minimise dust accumulation;
- surfaces, furnishing and fittings which can withstand recommended decontamination processes and which are cleanable;
- secure and prompt waste and laundry disposal.

Selection of multi-disciplinary team of specialists

3.16 There are a variety of contract agreements with regards to the Project Team involved in the development of the healthcare facility. Each facility should apply the type which is most suitable to them. Ideally, the Project Team will include specialists such as those described in [paragraph 3.22](#). Project Team members should have the appropriate authority to make and action decisions with regard to infection prevention and control.

Assembling the Project Team

3.17 The Project Team should be assembled as soon as possible to ensure that an accurate design brief is developed. Regular meetings with stakeholders referred to in [paragraph 3.22](#) to discuss design, tendering, build and commissioning will ensure the facility is functionally suitable and fit for purpose. Regular communication during the construction and commissioning stages should also ensure that prevention and control of infection risks are highlighted and subsequently eliminated or mitigated.

Selection of consultants

3.18 The main source of guidance for procurement of healthcare facilities in Scotland is PROCODE, produced by Health Facilities Scotland. PROCODE gives guidance on the selection of consultants and is designed to compliment the Scottish Capital Investment Manual (SCIM).

- 3.19 Every consideration should be given to the quality of composition of the Design Team, including client representatives. Selection of Design Teams entirely, or primarily, on cost is contrary to public sector procurement requirements which demand a best value approach. The quality of the Design Team, including knowledge and understanding of healthcare associated infection, should be a key criteria in the selection of the Design Team. The design brief and/or output specification are critical in achieving a high quality environment.

Roles and responsibilities

- 3.20 Communication between all parties is paramount in order to ensure that prevention and control of infection risks are highlighted and then either eliminated or managed. The quality of the healthcare facility design and the subsequent tendering and construction phase will be enhanced if all potential risks and interactions with other services are fully examined and discussed as early in the process as practicable. This can be achieved if there is frequent communication and continuous co-operation between the Design Team and the successful Contractor during each stage of the healthcare facility development. Such participation can ensure that prevention and control of infection issues can be controlled promptly and effectively.
- 3.21 Demonstration of the decision making process e.g. minutes or project evaluation and records of significant decisions should be kept.

Representatives on Project Team

- 3.22 To ensure all infection issues are highlighted, input is needed from a wide variety of sources. The following list highlights some of the groups which need to be represented; each member of the Project Team must be competent in their designated area.
- a) **Project Director**
Responsible for creation and management of the Project Team for delivery of a system which minimises infection in both the construction of operation of the facility.
 - b) **Client/Department representative**
To represent ward, department or work area. Required to represent end users to ensure the facility will be functionally suitable and fit for purpose.
 - c) **Infection Control Specialists - representatives from the Infection Control Team**
To ensure prevention and control of infection issues are considered at the planning stage, particularly where work may impact on existing services during the construction phase. Incorporate best practice into the final design and to review post occupancy.

Infection Control may also advise on cleaning and decontamination regimes to be operated post occupancy and to give input in areas such as storage space requirements or clean/dirty workflows.

d) **Design Team (to include Architects, Services Consultants, Planning Supervisor and Clerks of Works)**

To seek the advice of all the relevant professionals and incorporate their views into the final design of the healthcare facility. The Planning Supervisor, in accordance with the Construction, Design and Management Regulations (CDM), has the responsibility to review the Contractor's proposed project programme and advise the Client whether the works can commence. Throughout the project, the Contractor should provide method statements for discussion with the Planning Supervisor and Design Team before any significant elements of work are undertaken, records of which must be kept.

e) **Facilities services**

Depending on the management arrangements, the following functions may need to be represented. This list is not exhaustive and other groups should be consulted as needed.

- i. Infection Control Manager;
- ii. Domestic;
- iii. Waste;
- iv. Estates;
- v. Catering;
- vi. Portering;
- vii. Security;
- viii. Fire;
- ix. Procurement;
- x. Sterile services;
- xi. Linen and laundry services

Information from these can be used to inform the Design Team and to amend existing schedules before and during the construction phase.

f) **Contractor**

To work with the Design Team to provide a manageable programme of works, ensuring that views of stakeholders and risks identified by the various stakeholders are effectively managed. This is subject to review by the Planning Supervisor (see [paragraph 3.22 d](#)) – Design Team).

4. Importance of education

- 4.1 Due to HAIs multi-factorial nature, education is not only necessary for Infection Control Specialists. There is a necessity that staff involved in the procurement, design, construction and maintenance of the healthcare facility should be appropriately educated in prevention and control of infection and should be able to demonstrate their knowledge and understanding of the area.
- 4.2 The nature of the issue means that both the clinical and non-clinical environment are affected. An environment which is designed to be fit for purpose, which limits the risk of infection spread by incorporating facilities, design features and fabrics that facilitates the promotion of standard precautions e.g. hand-hygiene, cleaning, disinfection, decontamination, patient isolation/segregation and waste disposal facilities is therefore essential.
- 4.3 Training on prevention and control of infection for these groups of staff is available from a variety of sources, and ranges from basic mandatory induction training to more specialist training at Post-Graduate level. An HAI module aimed specifically at these groups of staff has been incorporated into Glasgow Caledonian University's MSc Healthcare Property and Facilities Management. The module is also available outwith the MSc as a continuing professional development course.
- 4.4 One of the key priorities outlined in the Ministerial Action Plan 'Preventing infections acquired while receiving healthcare' HDL(2002)82, was the introduction of mandatory induction training on HAI for healthcare workers. Based on the principle that the greater number of healthcare workers with direct or indirect patient contact who have an understanding of the Standard Infection Control Precautions, the greater the chance of promoting high personal standards and behaviours, and reducing the prevalence of HAI within NHSScotland.
- 4.5 NHS Education for Scotland (NES) has developed a multidisciplinary prevention and control of infection educational programme entitled 'The Cleanliness Champion'. The programme is designed for staff with direct patient contact, and introduces the concept of standard precautions being applied at all levels of care to protect patients and staff from infection risk. Further information on training on HAI can be found at www.nes-hai.info/.

5. Risk management

5.1 Risk management involves three stages:

1. Identifying risk.
2. Assessing risk.
3. Managing the identified risk by elimination or by using controls to reduce the severity of risk.

Identifying risk

5.2 The time taken to plan or refurbish a healthcare facility can vary from a relatively short period in the case of urgent renovation, to as long as three or four years for a major capital build project. It is therefore important that Infection Control Teams are notified of capital bids or contracts given to Architects at the earliest opportunity. The Infection Control Team need to be involved in the first planning meetings. Most meetings thereafter will require some input from them.

5.3 To avoid mistakes and pitfalls the Project Team must consider issues including:

- How will the product, equipment, room or clinic be used?
- What possible solutions are available?
- What are the budgetary limitations?
- Which prevention and control of infection principles or external regulations apply?
- What does the evidence suggest in relation to the specific context?
- What are the laws governing the project?
- What are the standards and guidelines from architectural and engineering bodies, government departments and accrediting agencies?
- Which product or design best balances the infection control requirements with employee and patient safety and satisfaction, and cost constraints? (Carter and Barr, 1997.)

Common pitfalls

5.4 Common pitfalls arise from a number of pressures, for example, the pressure to choose the cheapest products or design. As many authors have argued, the best products or designs may be more expensive initially but in the long term they will probably realise cost benefits as they may prevent outbreaks, or they may last longer and require less maintenance and be more durable.

Common errors

- 5.5 Common errors in design and construction (adapted from Carter and Barr, 1997) due to inept or non-existent risk management include:
- air intakes placed too close to exhausts or other mistakes in the placement of air intakes;
 - incorrect air turnover and airflow patterns;
 - air-handling systems which function only during the week or on particular days of the week;
 - ventilation systems which are not fully commissioned;
 - negative air-pressure rooms being omitted from large, new inpatient buildings;
 - carpet placed where vinyl should be used;
 - aerators on taps (also avoid swan-neck outlets where possible);
 - sinks located in inaccessible places;
 - patient rooms or treatment rooms which do not have sinks in which healthcare workers and visitors can wash their hands;
 - doors too narrow to allow beds and equipment to be moved in and out of rooms;
 - inadequate space to allow safe use of medical devices and equipment.
- 5.6 Carter and Barr reported these errors they had encountered during construction projects in their practice of prevention and control of infection. They recommended that Infection Control personnel inspect the construction site frequently to make sure the workers are following the correct guidance.

Assessing risk

- 5.7 Outbreaks of infection have been related to the design, plan, layout, function and/or finish of the built environment (Cotterill et al, 1996; Kumari et al, 1998). Thus, risk assessment is a fundamental imperative in the planning and design stages of a healthcare facility, yet it is often overlooked or compromised throughout the lifecycle of the project. Disseminating good specialist knowledge and involving Infection Control Teams throughout all phases of construction and renovation projects will reduce risks. Failure to properly assess prevention and control of infection risk can lead to expensive redesign later and expose the patient and healthcare worker to prevention and control of infection hazards.

Managing the risk

- 5.8 Part of the Infection Control Team's role is to help non-clinical professionals to understand the main principles of how infection is spread in the context of the built environment.

5.9 When evaluating the spread of infection and its control, three aspects should be considered:

- source;
- mode of transmission; and
- susceptible recipient.

These principles should be applied to all stages of the development of the healthcare facility.

Source

5.10 Building professionals must be convinced about the risks associated with construction projects, and that the environment can be a reservoir for potentially infectious agents. The source is the person, animal, object or substance from which an infectious agent is transmitted to a host. The immediate healthcare environment can be a potential reservoir of micro-organisms and source of infection or contamination, therefore, Designers and Planners need to consider eliminating potential sources of infection by practising good design, for example:

- storage facilities;
- choice of materials, avoiding unnecessary surfaces that may become reservoirs for infectious agents;
- ensuring materials and surfaces can be cleaned and maintained.

5.11 It has been reported (Rampling et al, 2001) that antibiotic-resistant bacteria, such as meticillin-resistant *Staphylococcus aureus* (MRSA), may survive and persist in the environment leading to recurrent outbreaks.

5.12 Attention to prevention of airborne infection by the use of ventilation in specialised areas and correct engineering and mechanical services contribute greatly to reducing potential reservoirs of infection in the built environment.

5.13 Elimination of other environmental sources of infection, for example pests, litter, insects, birds, small mammals and waste, should be considered at the outset of a project and reviewed throughout. Common pests include rats, mice, ants, cockroaches, pigeons and flies. All carry micro-organisms on their bodies and in their droppings. Healthcare facility hygiene is dependent on controlling pests.

Mode of transmission

5.14 A basic understanding of modes of transmission of infection assists in promoting joint responsibility for prevention and control of infection. Micro-organisms can be transmitted in three main ways:

- **direct** transmission involving direct transfer of micro-organisms to the skin or mucous membranes by direct contact;

- **indirect** transmission involving an intermediate stage between the source of infection and the individual, for example infected food, water or vector-borne transmission by insects;
- **airborne** transmission involving inhalation of aerosols containing micro-organisms, for example legionnaires disease or tuberculosis.

5.15 Environmental dispersal of micro-organisms during construction, resulting in HAIs, should also be emphasised to non-clinical members of the Project Teams.

5.16 There is a need to assess the infection risks during construction and how construction activity itself may be a mechanism for dissemination of infection; for example, environmental airborne contaminants and infectious agents are closely related to water and moist conditions which feature prominently in construction activity.

Susceptible recipient

5.17 Preventing transmission of infectious agents to vulnerable patient populations, healthcare workers and visitors is an important component of prevention and control of infection programmes.

5.18 Outbreaks of infection, affecting immuno-compromised patients, have been reported, and construction professionals need to understand the concept of the at-risk patient. Some groups of patients are especially susceptible to certain infectious agents to which they may be exposed in the healthcare construction environment.

Conclusion

5.19 The integration of prevention and control of infection risk management and construction is in its infancy. It represents a significant change in the management of healthcare facilities design and planning which will take time to develop to a level at which the greatest benefits can be achieved. Just as important then is the need to carry out research in the area of risk management, prevention and control of infection and the built environment to produce sound irrefutable evidence on which to base further risk management strategies.

Important

- always consult the Infection Control Team at an early stage:
 - whenever refitting or refurbishment is planned;
 - whenever major capital bids are planned;
- do not wait until patients are ready to move in;
- do not wait until fixtures, fittings and furnishings have been purchased;
- do not let cost or space consideration override reason;
- most advice will be commonsense but not always popular financially.

6. Legislative issues

Health and safety

- 6.1 Due to the complexity of the process of developing a new healthcare facility, there is a great scope for errors and omissions which can affect the delivered facility in terms of its ability to contribute to, or at least limit the spread of infection.
- 6.2 HAI is a health and safety issue and the actions or omissions of those involved in the provision or operation of the facility could become evidence in any legal action stemming from an infection. For this reason it is essential that, as with other considerations of professional competence, all those involved in the commissioning, procurement, design and planning and construction refurbishment or ongoing maintenance are able to demonstrate that appropriate expertise was in place and advice sought.
- 6.3 A number of pieces of legislation put the primary responsibility for the safety of the facility, including HAI, on the employer, usually the NHS Board. In construction procurement the 'employer' sets the resource, assesses the competence of the Design Team and evaluates the output. This means the employer should lead on setting the quality culture that will deliver a safe environment.

Health and Safety legislation and prevention and control of infection

- 6.4 It is important to remember that many of the recommendations in this guidance, while evidence based, may also be required by Health and Safety law in respect of controlling the risk of infection to staff and patients. This needs to be taken into account during the process of planning, designing and maintaining healthcare premises, as this will clearly influence the final outcome. The following outlines some of the key features of relevant legislation which impinge on the control of infection. Other relevant legislation may also be applicable.

Health and Safety at Work etc Act 1974

- 6.5 The duties of employers under the Health and Safety at Work etc Act 1974, including protecting the health, safety and welfare of employees, extends to patients and others who may be affected by any work – this includes control of infection measures.

The Provision and Use of Work Equipment Regulations (PUWER) 1998

- 6.6 Anyone involved in the supply of equipment, plant or machinery for use at work has to make sure that, as far as is reasonably practicable, it is safe and does not cause any risk to health when used at work.

For example:

- equipment should be made of materials that can easily be cleaned and which do not support microbial growth;
- plant or equipment which needs regular cleaning should be easy to access and easy to dismantle.

The Construction (Design and Management) Regulations 1994 (CDM) (as amended 2000)

- 6.7 These Regulations require that health and safety is taken into account and managed throughout all stages of a project, from conception, design and planning through to site work and subsequent maintenance and repair of the structure. These Regulations apply to most common building, civil engineering and engineering construction work (including demolition, dismantling and refurbishment).
- 6.8 The NHS Board has Client responsibilities under these Regulations; it has to pass relevant reasonably available information about health and safety matters which relate to the project to those who are responsible for planning the project.
- 6.9 The CDM Regulations state that Planning Supervisors have responsibility to review the Contractor's proposed project programme and advise the Client whether the works can commence.

The CDM Regulations also state that Designers should:

- ensure that when they design for construction they assess the foreseeable health and safety risks during construction as well as the eventual maintenance and cleaning of the facility in the balance with other design considerations such as aesthetics and cost. This can be achieved by applying the normal hierarchy of risk control;
- identify all the hazards inherent in carrying out the construction work and, where possible, alter the design to avoid them. If the hazards cannot be removed by changing the design, then the risks will need to be controlled and the designer should provide information about the remaining risks.

The Control of Substances Hazardous to Health (COSHH) Regulations 1999

- 6.10 COSHH provides a framework for controlling the risks from most hazardous substances, including biological agents, which can contribute to the risk of infection.
- 6.11 COSHH requires that employers assess the risk from all infectious agents to both their employees and others who may be affected by their work, for example patients. The assessment needs to be suitable and sufficient and must cover the steps that need to be taken to meet the requirements of the rest of the Regulations. This means that the assessment should also review the use of control strategies, the maintenance and use of control measures such as air

handling systems and air filtration, health surveillance requirements and, perhaps most importantly, information, instruction and training for employees.

6.13 There are a number of general measures in COSHH relating to the control of exposure to biological agents which must be applied in the light of the results of the assessment. Other procedural/management control measures must also be applied if employers are to fully meet their duties under COSHH including:

- keeping as low as practicable the number of employees exposed or likely to be exposed to biological agents;
- designing work processes and engineering control measures so as to prevent or minimise the release of biological agents into the place of work;
- displaying a biohazard sign and other relevant warning signs;
- drawing up plans to deal with accidents involving biological agents;
- specifying appropriate decontamination and disinfection procedures;
- instituting means for the safe collection, storage and disposal of contaminated waste, including the use of secure and identifiable containers, after suitable treatment where appropriate;
- making arrangements for the safe handling and transport of biological agents, or materials that may contain such agents, within the workplace;
- specifying procedures for taking, handling and processing samples that may contain biological agents;
- providing collective protection measures and, where exposure cannot be adequately controlled by other means, individual protection measures including, in particular, the supply of appropriate protective clothing or other special clothing;
- where appropriate, making available effective vaccines for those employees who are not already immune to the biological agent to which they are exposed or liable to be exposed;
- instituting hygiene measures compatible with the aim of preventing or reducing the accidental transfer or release of a biological agent from the workplace including in particular, the provision of appropriate and adequate washing and toilet facilities and the prohibition of eating, drinking, smoking and application of cosmetics in working areas where there is a risk of contamination by biological agents.

6.14 'Appropriate' in relation to clothing and hygiene measures means appropriate for the risks involved and the conditions at the workplace where exposure to the risk may occur.

7. Procurement and construction process

Overview

- 7.1 The procurement and construction of a healthcare facility is a highly complicated process and requires input from a wide variety of sources. During the procurement and construction process, reference should be made to existing guidance relating to the procurement and construction of healthcare facilities such as that contained in the Scottish Executive Health Department's Scottish Capital Investment Manual (SCIM).
- 7.2 Infection Control Specialist input is essential in relation to procurement at the design and planning stage of a project. There is a case for stipulating that Architects and Designers for healthcare projects should be able to demonstrate their knowledge and understanding of prevention and control of infection.
- 7.3 The specification of building materials, especially surface finishes, healthcare facility equipment etc should take account of the input from the Infection Control Specialist.
- 7.4 The Scottish Capital Investment Manual (SCIM) comprises a number of guidance booklets covering the following areas:
- Overview;
 - Project Organisation and Management;
 - Private Finance Guide;
 - Business Case Guide;
 - Management of Construction Projects;
 - Commissioning a Healthcare Facility;
 - Information Management and Technology Guide;
 - Post Project Evaluation.
- 7.5 Other sources of information which should be consulted include Health Facilities Scotland procurement guidance PROCODE which provides an insight into the contracting aspects of health building projects, including the implementation of national policy and EU directives. PROCODE provides guidance on a wide range of procurement issues including the appointment of Works Contractors and Consultants and the use of various forms of contract.
- 7.6 Prevention and control of infection issues associated with procurement and construction need to be given appropriate priority and consideration. Recommendations and the incorporation of recommendations should be documented. It is therefore essential that the advice of Infection Control Specialists should be sought as a routine feature of the procurement and construction process and HAI-SCRIBE should be applied at the appropriate

stages of procurement and construction. The involvement of Infection Control Specialists and the application of HAI-SCRIBE is not restricted to certain levels of project expenditure but rather is applicable to all procurement and construction processes.

- 7.7 Health and safety considerations are an important feature at this stage and at least some of the health and safety considerations will influence final outcome in terms of prevention and control of infection. The duty of employers to protect employees also extends to patients and others who may be affected by inappropriate prevention and control of infection measures.

8. Evaluation of site for development

- 8.1 Due to the complexity of the management of HAI, especially in relation to the built environment, input from a wide variety of sources is necessary for success.

Selection of multi-disciplinary team of specialists for implementation of HAI-SCRIBE

- 8.2 HAI-SCRIBE aims to manage infection risks through the development of a prevention and control of infection questionnaire. The system highlights the need for a multi-disciplinary team of specialists with appropriate skills to ensure its implementation. This is an essential requirement in terms of the evaluation of the site for development. Inappropriate decisions, or a less than rigorous investigation of the site, may well result in infection problems being identified at a later stage when it may be very difficult or indeed impossible to remedy the situation. Remediation of the situation may also prove expensive and investment at this stage may pay dividends over the life of the facility.
- 8.3 The multi-disciplinary team of specialists may include, amongst others:
- an Architect;
 - a Building Services Engineer;
 - an Infection Control Specialist with experience/knowledge of the built environment;
 - a Risk Manager;
 - an Estates/Facilities Manager.

Record of decision-making

- 8.4 A record of significant decision-making should be maintained. Such a record is evidence of 'due diligence' and helps to ensure that prevention and control of infection issues are implemented. Good practice requires implementation of a risk management system such as HAI-SCRIBE, this being an accurate record of the process of hazard assessment and risk management. Signing off by the Infection Control Specialist at each stage of the development, including this stage of the evaluation of the site, should be considered an essential step.

Pollution/contamination

- 8.5 Pollution from external sources can contribute to the spread of infection within the built environment (e.g. ingress of *Aspergillus* spores or *Legionella* bacteria during earthworks). Limitation of external pollution can go some way to controlling the spread of infection within the built environment.
- 8.6 HAI-SCRIBE highlights in its question sets, the potential for infection risk when consideration is being given to a proposed site for development. Research into the history of the area being proposed for development, together with a rigorous

examination of existing industries and businesses, will highlight any potential for infection risk and the measures which may be appropriate to manage the infection risk. Failure to be rigorous in relation to the historical research of the area and the examination of existing industries in the area may result in infection risks not being identified until it is too late to effectively manage them. Specialist external advice is likely to be necessary.

- 8.7 There are other pollution/contamination issues which may also need to be identified and addressed, even if these are not infection risks e.g. land contaminated by chemicals, asbestos etc.

Topography of site

- 8.8 When considering the topography of the proposed site for development, issues such as the prevailing wind direction and the associated prevention and control of infection issues need consideration.
- 8.9 For example, the positioning of the healthcare development in relation to cooling towers in the area and the potential infection risk from entrainment of vapour plumes containing *legionella*.

Implication of choosing natural ventilation

- 8.10 Adequate ventilation in healthcare facilities is essential for fresh air supply, odour dilution and the removal of airborne contamination.
- 8.11 In relation to evaluation of a site for development, consideration should be given to how the foreseeable conditions of the site will affect the performance of the ventilation system chosen.
- 8.12 In areas where the functioning of the ventilation system is critical to the minimisation of HAI risks, a mechanical ventilation system is most likely to be appropriate. The possibility for contaminants to be introduced in the fresh air supply from sources such as earthworks or cooling towers should be considered.
- 8.13 Where 'natural' ventilation is considered, this falls into two broad categories; controlled and uncontrolled. Uncontrolled 'natural' ventilation is most frequently seen as opening windows. Its performance is not predictable and as such, it is inappropriate as a strategy for ventilation in areas where controlled conditions are required. Uncontrolled natural ventilation allows contaminants such as fungal spores to be introduced to the ventilated space in untreated air when windows are open. Conversely, when windows are closed, dilution of contaminants in the ventilated space will be greatly reduced.
- 8.14 Between these two extremes is controlled natural ventilation where the ventilation, whilst not provided through a conventional ducted ventilation system, is designed, engineered and maintained to provide predictable performance.

- 8.15 As such a system is likely to be more affected than a mechanical system by external influences such as weather conditions, its design will require specialist knowledge. This type of system may involve filtration of incoming air but will not generally involve other air treatment such as heating. The motive force for the air will often be the buoyancy of air at room temperature, however, this entails relatively low pressure differentials which will constrain the type of filtration used.
- 8.16 Although air-conditioning may seem a straight-forward solution to the control of the environment, it is expensive to run and not environmentally sustainable on a large scale. Within the working life of buildings being built now, restrictions in Carbon Dioxide emissions allowances are likely to preclude the routine use of air-conditioning. For this reason, sites which necessitate sealed, air-conditioned buildings should be avoided.

Impact of activities in the surrounding environment

- 8.17 Activities occurring in the surrounding environment can contribute to the spread of infection. For example, there may be construction/demolition works programmed in the neighbourhood which may present a risk e.g. fungal contamination arising from earthworks. Measures to limit these risks should be implemented.

Constraints of developing on a pre-determined site

- 8.18 In some cases the use of a particular site is unavoidable and in this case, steps must be taken to minimise any adverse conditions inherent on the site. HAI-SCRIBE highlights in its question sets the potential for infection risk arising from restraints on the development of a pre-determined site. For example, will lack of space limit the proposed development and any future expansion of the facility (e.g. to increase single room provision) and might this create or increase a risk of infection? Will the proposed development impact on the surrounding area in any way which may lead to restrictions being applied to the operation of the proposed facility which may in turn present potential for infection risk (e.g. storage and collection arrangements for healthcare waste).

Strategic planning

- 8.19 Infection Control Specialist input is essential at the strategic planning stage. It is never too early to have prevention and control of infection input.
- 8.20 To allow Infection Control Specialists to effectively participate in the planning process for both renovation and new-build projects, it is necessary for them to understand the process from its inception to completion.
- 8.21 A comprehensive approach to planning needs to include consultation with the appropriate specialists from inception through to post-project evaluation. The Project Team should include specialists as described in [paragraph 3.20 of Section 3](#).

9. Design and planning stage

- 9.1 At the design and planning stage, it is crucial that hazards associated with infection risk should be identified and assessed, and measures taken to manage these risks. It is essential to 'design in' at the design and planning stage, measures which will eliminate or minimise the impact of identified hazards and effectively manage the risk of infection. Reference should be made to the question sets contained within HAI-SCRIBE.

Strategic planning and the role of prevention and control of infection

- 9.2 In the 'National Overview for Improving Clinical Care in Scotland: Healthcare Associated Infection (HAI); Infection Control', NHS Quality Improvement Scotland (QIS) prescribes that prevention and control of infection are considered as part of all service development activity. In the USA, the current authority for construction, design for federal and healthcare providers is the 2001 edition of 'Guidelines for Design and Construction of Hospital and Healthcare Facilities' published by the American Institute of Architects/Academy of Architecture for Health (2001) with assistance from the US Department of Health and Human Services; http://www.aia.org/aah_gd_hospcons. The latest version strongly supports prevention and control of infection input at early planning and design stages.
- 9.3 For Infection Control Teams to effectively participate in the planning process for both renovation and new-build, it is necessary for them to understand the process from its inception to completion.
- 9.4 Where significant refurbishment is being considered, or the use of an existing patient facility is being planned, Infection Control Specialist input is essential at the strategic planning stage. It is never too early to have prevention and control of infection input.
- 9.5 To allow Infection Control Specialists to effectively participate in the planning process for both renovation and new-build projects, it is necessary for them to understand the process from its inception to completion.
- 9.6 The organisation of the Project Team involved in Strategic Planning is given in [paragraph 3.22](#) of [Section 3](#).

The planning process

- 9.7 The planning process, although refurbishment work may be different, is comprised of the following stages:
- the concept/feasibility study;
 - sketch plans;
 - the preparation of a business case to support the viability of the project;

- project funding;
- the design stage;
- project monitoring;
- commissioning the facility;
- post-project evaluation.

Table 2 highlights the infection control input required at each stage.

- 9.8 Its aim is to prompt those with overall responsibility for managing capital schemes or Private Finance Initiative/Public Private Partnerships (PFI/PPP) to include prevention and control of infection advice at the right time in order to prevent costly mistakes.

These points are expanded upon in more detail below.

Concept/feasibility study

- 9.9 The planning process starts with the identification of a 'need' by the users. The development of this need will involve feasibility studies to enable a design brief or output specification to be developed. The Infection Control Team should review operational policies and procedures at this stage and there may be 1/200 designs to give a broad overview of the scheme. The Infection Control Team needs to consider:
- the effect additional beds or departments will make to policies such as waste disposal, linen and catering, etc.;
 - the effect of extra theatres on decontamination services, workflow, etc.;
 - additional specialised areas that will probably require extra infection control and laboratory input as well as specialist advice which may not be available in-house e.g. bed space and size of departments, etc., plus engineering services needs such as ultra-clean ventilation, showers baths, etc.

Further details on this process can be found in Table 2.

Space planning

- 9.10 There are a number of issues in terms of design and layout which could contribute to the risk of transmission of micro-organisms. For example, the design of the ventilation system needs to inhibit contamination spread rather than contribute to it. The internal and external routes identified for removal of dirty laundry, waste food, healthcare waste, similarly need to be planned so as to inhibit rather than encourage contamination.
- 9.11 There should be adequate space within the healthcare facility for storage of consumables, for example, there should be adequate storage in theatres for small orthopaedic implants.

- 9.12 The location of departments, theatres, wards and rooms needs to take account of good prevention and control of infection practice and ensure that workflows are designed to inhibit infection spread.
- 9.13 It is very important that the design and layout of the healthcare facility should inhibit the spread of infection. Reference should be made to HAI-SCRIBE and its question sets in relation to this.
- 9.14 Workflow systems should facilitate travel from clean to dirty to clean but never back again to clean. This principle is important in terms of limiting infection spread.
- 9.15 Correct workflow systems must be maintained throughout the building project. Input from Infection Control Specialists is essential at the planning stage of the project, requiring close collaboration between Infection Control Specialists and the Design Team. This is especially important in the planning of specialised units, for example, theatres and critical care.
- 9.16 Most healthcare departments have clean-to-dirty area flow systems. Workflow is a basic element of good prevention and control of infection practice and this needs to be reflected when the built environment is being planned.

Sketch plans

- 9.17 The remaining 1/200 designs will be available at this stage and the Infection Control Team needs to give a broad view of prevention and control of infection issues such as:

- missing rooms;
- wards without ancillary areas.

Additional considerations at this point will include:

- storage;
- ancillary areas;
- single rooms;
- isolation rooms;
- changing facilities;
- lifts;
- pneumatic delivery systems.

The business case

Outline business case

- 9.18 The preparation of a business case is the process that supports NHS Board submissions for funding of new capital projects. A business case must convincingly demonstrate that the project is economically sound, is financially

viable (affordable to the NHS Board and purchasers) and will be well managed. In addition, a business case for any investment should show that it will benefit patients. An overview of the capital investment process is given in the Scottish Capital Investment Manual (SCIM).

9.19 The involvement and support of a wide range of managers and staff is vital to the success of the business case, both to determine the requirement and scope of the investment and also to participate in subsequent stages of planning. It is important therefore at this stage to identify and involve key people who have a direct interest in the end product. This will include members of the Infection Control Team along with other leading clinicians, nursing managers and departmental heads. Specifically at this stage, Infection Control Teams need to:

- establish the goals of prevention and control of infection. What prevention and control of infection risks are especially important for each specific context;
- agree the agenda for prevention and control of infection design and planning;
- communicate prevention and control of infection imperatives throughout the course of the project, but especially at the initial stages;
- monitor the progress of the building/refurbishment project in relation to compliance with infection control specifications;
- determine available resources that can be used and recognise the cost benefits of not cutting corners on prevention and control of infection issues.

9.20 Normally the input from the Project Team should be managed by the Project Director. For larger and more complex schemes, a Project Manager reporting to the Project Director may be appointed to conduct the detailed work and manage the Project Team.

Issues to be addressed by the Infection Control Team

9.21 The Infection Control Team must ensure that prevention and control of infection implications are not compromised by reducing or overcrowding in clinical areas. The issues frequently addressed will include costs and space constraints which will impact on areas such as:

- storage and equipment cleaning areas;
- ventilation;
- hand hygiene facilities;
- furnishing;
- appropriate finishes;
- isolation rooms/rooms used to segregate patients;
- specific products with infectious implications;
- applicable regulations;

- domestic services room.

Detail planning

- 9.22 It is at this stage, when the outline business case is presented, that the 1/50 designs will be available. There will probably be two stages to the consultation process:
1. Early on in this period the Infection Control Team will need to discuss location of rooms for correct workflow/prevention and control of infection practice, i.e. wards, theatres and patient passage through out-patients or primary care facilities, etc.
 2. Later there will be a need to discuss the finer details such as where fixtures and fittings are located, what type of flooring, cupboards or storage systems are to be used, and ventilation in theatres, etc.
- 9.23 The Infection Control Team will also need to think about the prevention and control of infection issues around:
- workflow;
 - hand-wash basins: types, numbers and location;
 - fixtures/fittings/flooring;
 - wastewater and sewage/body fluid disposal;
 - ventilation;
 - heating and lighting;
 - water systems;
 - suction/medical gases;
 - storage systems;
 - ward kitchens/pantry.
- 9.24 The business case process should highlight the variables that drive the facility's requirements with regard to prevention and control of infection. This is not always an easy task in the initial stages of a project. Table 4 gives a range of initial ideas.

	Planning Process																		Issues		
	Time Period																				
Risk management	Concept	■																	Issues to consider Space Cleaning/disinfection/Sterilization Specialist area Engineering facilities Waste Catering Laundry		
	Feasibility study		■	■	1 in 200 (some preliminary designs)													→			
	Sketch plans				■	■	1 in 200 draft activity data sheets equipment lists usually wish lists													→	Issues to consider Storage (linen, waste, patient equipment, domestic equipment) Ancillary areas Changing facilities Lifts Pneumatic delivery systems Single rooms Isolation rooms
	Outline Business Case					■															
	Detail planning/ design						■	■	■	1 in 50: fixtures and fitting (fixed items Group 1)										→	Issues to consider Ventilation Heat/light Water systems Sewerage Vacuum Hand-wash basins Storage systems Ward kitchens Workflow Fixture and fittings
	Full Business Case								■												
	Tender									■											
	Contract										■										
	Construction											■	■	■	■						
	Commission/equipping												■	■	■	■	■	■	Issues to consider Equipment Space Specialist equipment ↓ Check for any changes made to original agreement/plan		
	Evaluation																■				

Table 2: Project Development Chart

Typical Stages of Infection Control Input

1. **Concept/feasibility study:** Infection Control Team should review operational policies and procedures, e.g. 1/200 plans.

Adding beds to ward area may mean extra sluice or side rooms.

Adding extra theatres will need a review of decontamination services for instruments.

Additional specialised areas will need extra prevention and control of infection input.

2. **Sketch plans:** at this stage, the Infection Control Team needs to give a broad view of prevention and control of infection issues e.g. rooms missing, wards without ancillary areas such as disposal rooms or dirty utility.

3. **Detail planning/design:** (1/50 designs – early period)

There is a need to finalise locations of rooms for correct workflows/prevention and control of infection practice, i.e. wards, theatres.

4. **Detail planning/design:** (1/50 designs – later period)

Need to discuss finer details within rooms: location and type of fixtures and fittings, e.g. hand-wash basins/types of basins; airflows in theatres, flooring.

5. **Construction:** the Infection Control Team will need input here, particularly if the new build is attached to an existing healthcare building, to prevent risks to patients.

6. **Equipment:** decisions on equipment should be made as an ongoing process, but it is at this stage that it will be seen that previous equipment 'wish-lists' may not fit the rooms/departments or are now outdated. It is important that Infection Control Teams have input during this period (especially if it is a PFI/PPP build).

7. **Commission/equipping:** Infection Control Teams must have input during this stage if costly and dangerous mistakes are to be avoided.

8. **Evaluation:** this is an important stage in which lessons learnt can be highlighted for future projects, both within NHS Boards and throughout NHSScotland. Post-project evaluation is mandatory and results should be available to other Boards.

Table 3: The Key Stages of the Planning Process and examples of Infection Control input

Accommodation areas/internal environment/general services		Examples: Key issues and areas to be considered	
Accommodation areas			
Bed areas: <ul style="list-style-type: none">Single-bed rooms4-bedded bays versus 6-bedded bays		En-suite facilities. <ul style="list-style-type: none">Doors on baysEn-suite facilities	
Dirty utility/clean utility		Standardisation of rooms/ choice of equipment e.g. bed pan vs macerator. Space.	
Workflow/layout		Standard ward area versus specialised area.	
Bed Planning		Elective. Emergency.	
Linen services and facilities		Internal laundry versus commercial laundry.	
Catering/kitchen areas		Furnishing, fixtures and fittings plus workflow crucial for HACCP. Commercial systems e.g. cook-chill versus in-house systems.	
ITU/HDU		Single rooms versus 4/6 bed bays.	
Handwash basins		1 to 2 versus 1 to 4 versus 1 to 6 dependent on room types. Facilities to ensure compliance with hand hygiene guidance: sinks, taps, soap, gloves, aprons. Easily accessible for staff use.	
Staff change areas/storage of uniforms		Type of uniform provided will dictate, i.e. 'greens' versus classic.	
Decontamination facilities. CDU/LDU		Operational policy dictated by choice of decontamination strategy	
Equipment		Bed/mattresses. Endoscopes/instruments. Patient specific.	Purchase versus hire. Cleaning/disinfection requirement. Enough equipment available.
Priority areas			
<ul style="list-style-type: none">Critical careUCV TheatresHydrotherapyMortuariesSCBUs and maternity		<ul style="list-style-type: none">Renal unitsOncologyNeurologyPaediatricsDecontamination unitsPharmacy aseptic dispensary	
Every specialist area will have different requirements and infection control issues so cannot be planned as standard departments.			
Internal Environment			
Ventilation		Single rooms, bays, theatres, pacing rooms, treatment rooms, internal sanitary areas. Negative and positive pressure isolation rooms.	
Heating/ventilation		Dust-free options, i.e. hidden heat panels versus radiators.	
Lighting		Quantity. The use of sealed units.	
Furnishings, fittings and artwork		Walls/floors/ceilings – hygiene versus aesthetics.	
Water		Deadlegs. Water turnover. Appropriate temperature for hot and cold systems. Water coolers/fountains.	
General services			
Disposal of waste		In-house versus commercial. Storage.	
Communications		IT systems (timely information on pathology, etc, operational policies, infection control policies, procedures and training).	
Emergency plans		Water storage if water cut off/heating/medical gases and vacuum/suction/emergency generator. ventilation, etc.	

Table 4: Infection control issues to consider in the Capital Planning Process.
(Note: this is not an exhaustive list)

(Shaded boxes include examples of issues related to prevention and control of infection which might need to be considered.)

1. Set the strategic context:

- where are we now?
- where do we want to be?
- is it affordable?
- in-patient/day cases;
- single room issues;

2. Define objectives and benefit criteria:

- facilities for patients with antibiotic resistant infections;
- cost benefits of preventing healthcare associated infection.

3. Generate options.

4. Measure the benefits.

5. Identify/quantify costs.

6. Assess sensitivity to risk.

7. Identify the preferred option.

8. Present the outline business case.

9. Develop the preferred option: full business case.

Table 5: Typical steps in the business case process.

The HAI implications associated with using private finance

Dealing with HAI in PFI/PPP Projects

9.25

The Scottish Executive Health Department encourages the consideration of the strengths of the private sector and the use of privately raised capital. There are essentially two broad criteria against which all schemes are assessed: 'value for money' and 'assumption of risk'. NHS Boards are expected to explore the private finance alternative whenever a capital investment scheme is being considered. The goals of PFI/PPP are to:

- achieve objectives and deliver services more effectively;
- use public money more efficiently;
- respond positively to private sector ideas;
- increase competition.

Key factors in PFI/PPP

9.26 The contract between the NHS and the private sector supplier is critical and it is important that the service representatives/key stakeholders, and particularly in this instance, the Infection Control Team are clear about the options available and the evidence to back up any decisions they advise on. The Infection Control Team will need to make sure that certain criteria are embedded into the contract in such a way that important decisions on design or build do not go ahead without being 'signed off' by them. They should ensure that they have:

- access to all relevant and up-to-date plans and information on operational policies;
- access to any meetings deemed relevant to them or timely minutes from those meetings that they cannot attend;
- access to sites and departments as building work progresses, e.g. environmental rounds with checklists based on project objectives;
- regular communication between both internal Project Manager and the PFI/PPP team;
- involvement in decision making for any category of equipment the PFI/PPP team will purchase;
- involvement in any contracts for support services such as catering, cleaning, linen, decontamination unit, etc., that the PFI/PPP team may be providing;
- access to certain high risk areas for any microbiological testing deemed necessary, e.g. theatres, isolation/segregation rooms, pharmacy and decontamination unit, clean rooms;
- responsibility for HAI and actions to be taken, such as testing and remedial works, and that these terms are clearly specified in the contract.

Design stage

9.27 It is at the design stage that Infection Control Teams will need to follow up any input they have had in the initial brief. Sketch plans should be available to them to explain how the brief fulfils their requirements at the 1/200 and 1/50 plan stages of the project. Suggestions for improvement in operability are encouraged at this stage. (For an approximate time-scale, see [Table 2.](#))

9.28 Consideration should also be given to the impact on existing local facilities, e.g. ventilation, water supplies, etc.

Design and structure issues

9.29 The Infection Control Team will need to consider:

- if the facility is designed to support prevention and control of infection practice;

- design, number and type of isolation rooms (i.e. source or protective environments);
- heating, ventilation, and air-conditioning systems including filtration;
- mechanical systems involving water supply and plumbing;
- number, type and placement of hand-hygiene fixtures, clinical sinks, dispensers for soap, alcohol hand-rub, paper towels, and lotion;
- sharps disposal unit placement;
- accommodation for Personal Protective Equipment;
- surfaces: ceiling tiles, walls, counters, floor covering and furnishings;
- utility rooms: soiled, clean, holding, workrooms;
- storage of movable and modular equipment;
- clinical waste;
- linen (clean)/laundry (used);
- storage of used medical devices prior to transfer to CDU and storage for sterile medical devices.

Adapted from Bartley (2000).

- 9.30 Equipment schedules for Groups 2 and 3 based on room data sheets/layouts are prepared at this stage. (Further information can be found in Appendix 1.) Items available for transfer should also be identified which will allow schedules for new equipment to be prepared and costed and considered for compatibility with existing equipment. This is an important area for input by the Infection Control Team if costly mistakes are not to be made. (Further information can be found in Appendix 1.)
- 9.31 The purchase of equipment for Groups 2 to 4 will not normally take place until the operational commissioning period. However, it is important during the construction and equipment supply stage that there is involvement by the Infection Control Team in discussion of Group 2 equipment. Some Group 2 equipment may require to be fitted by the main Contractor and all may have significant design implications. This will ensure that this equipment is compatible with prevention and control of infection needs and also that proper inspection and testing can be agreed. (Further information can be found in Appendix 1.)
- 9.32 Technical commissioning of the building, services and equipment should include any areas that require inspection and testing to demonstrate compliance with prevention and control of infection standards, i.e. theatres, hydrotherapy pools, isolation/segregation rooms and clean rooms in pharmacy and Central Decontamination Units (CDUs). There is a legal requirement for compliance in CDUs and pharmacies.
- 9.33 Commissioning of the building services is frequently curtailed to meet deadlines or put in the hands of inadequately qualified or experienced personnel. This is

invariably to the detriment of user satisfaction, operational efficiency, HAI risk and running costs and should be avoided at all costs.

Tender/contract

- 9.34 The Infection Control Team should help review the tenders/contracts to assess the competence in relation to the technical nature of the build.

Monitoring the project

Construction (new build)

- 9.35 If the project is a new-build, monitoring will not normally be required by the Infection Control Team until the healthcare premises are at a stage when site visits can be arranged. Although Infection Control input is needed throughout the development of the healthcare facility, at this point it is important for the Infection Control Team to visit the site as soon as possible to familiarise themselves with the layout of the various departments. This will help them to detect any unidentified problems or ones caused by design changes.

Construction (new-build attached to existing site or refurbishment)

- 9.36 Infection Control Specialists agree that involvement of Infection Control Teams in refurbishment projects is important not only for ensuring that 'designed-in' prevention and control of infection is achieved, but also for assessing the potential risks to patients in existing buildings from dust, dirt and pathogens.
- 9.37 Measures that may limit the spread of dust, dirt and pathogens during construction include the following:
- undertake work in winter as the risk is lower for *Aspergillus* spp. and other fungal infections;
 - clean and vacuum areas under construction and the surrounding areas frequently;
 - place adhesive floor strips outside the door to the construction area to trap dust, these should be replaced regularly to remain effective;
 - seal windows, doors and roof-space to control dust;
 - wet-mop the area just outside the door to the construction area daily or more often if necessary;
 - use a high-efficiency particulate air (HEPA) filtered vacuum to clean areas daily or more often if necessary e.g where there is a greater risk of infection spread or a greater need for control of infection;
 - transport debris in containers with tightly fitting lids, or cover debris with a wet sheet;
 - remove debris as it is created; do not let it accumulate. Use dust extraction equipment where feasible;

- remove debris through a window when construction occurs above the first floor;
- do not haul debris through patient-care areas;
- remove debris after normal work hours through an exit restricted to the construction personnel;
- designate an entrance, a lift and a hallway that the construction workers must use and which are not used by patients, visitors or healthcare workers;
- shampoo carpets when the construction project is completed;
- commission hotel services with regard to cleaning during construction projects.

(Adapted from Carter and Barr, 1997.)

- 9.38 There is a need to ensure that Infection Control Teams document advice given on building developments and that this advice is followed and recorded. Similarly, Carter and Barr (1997) advise that a daily checklist is maintained during the progress of the construction project (see Table 6 below).

Barriers	
Construction signs posted for the area	Yes/No
Doors properly closed and sealed	Yes/No
Floor area clean, no dust tracked	Yes/No
Air handling	
All windows closed behind barrier	Yes/No
Negative air at barrier entrance	Yes/No
Negative air machine running	Yes/No
Project area	
Debris removed in covered container daily	Yes/No
Trash in appropriate container	Yes/No
Routine cleaning done on job site	Yes/No
Traffic control	
Restricted to construction workers and necessary staff only	Yes/No
All doors and exits free of debris	Yes/No
Dress code	
Appropriate for the area (e.g., Theatres, CDU)	Yes/No
Required to enter	Yes/No
Required to leave	Yes/No

Table 6: Daily construction survey (Carter and Barr, 1997)

Surveillance and monitoring during renovation or construction work

- 9.39 Routine bacteriological sampling of floors, walls, surfaces and air is rarely indicated (Ayliffe et al, 2000), but there have been several documented outbreaks due to construction work. In 1995 there was widespread contamination of potable water with *Legionella pneumophila* during a period of major construction resulting in two fatal cases of healthcare associated legionellosis (Mermel et al., 1995). Multiple outbreaks of healthcare associated aspergillosis have also been described, including one specifically attributed to hospital renovation (Flynn et al., 1993). Mermel et al. (1995) suggest that heightened surveillance and preventive measures may be warranted during periods of excavation on hospital grounds or when potable water supplies are otherwise shut down and later depressurised.
- 9.40 NHS Estates (Wearmouth, 1999) advises:
- “Where vulnerable patients may be placed at risk, it is important that an appropriate risk assessment be carried out with the microbiologist/infection control officer [doctor] at an early stage in advance of any demolition works or disturbance/alterations to the building fabric/ventilation systems.”*
- 9.41 Since the airborne spores of *Aspergillus* spp. can travel significant distances, this will apply generally to all works in the immediate vicinity or within the boundary of the healthcare site. It is strongly advised that any recommendations by the Microbiologist/Infection Control Doctor should be incorporated into the building or engineering works so as to minimise risk.
- 9.42 Surveillance and monitoring during renovation or construction work may prove difficult; environmental assessment to detect *Aspergillus* spp. and to confirm epidemiological investigations may not be within the remit of all Infection Control Teams. However, implementation of adequate prevention and control of infection measures during construction are, and have been proven to be, an effective means of protecting highly susceptible or high risk patients from environmental contaminants (Thio et al., 2000).

Commissioning/equipping the healthcare facility

- 9.43 Upon completion of construction, the facility must be brought into use; the complexity of the task involved generally means that a Commissioning Manager and Commissioning Team will be needed. Senior managers, specialist teams and users should be fully involved in the process. The commissioning entails:
- drafting operational procedures;
 - establishing baseline and future staffing profiles;
 - establishing baseline and future revenue budgets;
 - establishing final equipment requirements;
 - identifying policy issues for referral to the Commissioning Team or the construction project team;

- identifying staff training needs;
- establishing the occupation programme for each user function, for incorporating into the overall masterplan.

9.44 Members of Infection Control Teams with an understanding of the commissioning process should ensure that they are included in any working groups in which infection prevention and control will have an impact, or in which requirements to modify services may have repercussions on other aspects of the prevention of infection.

9.45 The Infection Control Team may also need to be involved in processes for:

- transfer of facilities;
- phased or staged occupation;
- decorating;
- strategy for equipping;
- selection of equipment;
- storage and subsequent cleaning/disinfection of any furniture or equipment;
- commissioning hotel services for cleaning;
- site visits;
- artwork;
- furnishing and fittings;
- interior finishes and fixtures;
- post-handover period;
- decommissioning of redundant facilities;
- period of handover to operational management.

Post-project evaluation

9.46 The purpose of the post-project evaluation is to improve project appraisal, design, management and implementation. Although post-project evaluation is mandatory, it is a learning process and should not be seen as a means of allocating blame. There are three stages:

1. Project appraisal.
2. Monitoring and evaluation of project.
3. Review of project operations. It is at the third stage when it is useful for the Infection Control Team to be included in the evaluation teams that are reviewing project objectives. The outcomes (activity and its consequences) of the project will not be amenable to evaluation until the facility has been in use for some time.

Successful post project evaluation is aided by independence from the Procurement Team.

- 9.47 It is important that the project is evaluated in terms of its original objectives, not in light of any new legislation or development. Performance indicators may be used if these can be measured retrospectively. Control of infection related to measurable objectives may include:

- bed turnover;
- re-admission rates;
- incidence of day surgery;
- activity data;
- infection rates;
- patient satisfaction surveys, etc;
- process measures – air sampling, audit.

- 9.48 Reference should be made to HAI-SCRIBE and its question sets relating to the design and planning stage of any development.

Logistics

- 9.49 In addition to the issues raised in [paragraph 9.10](#) 'Space planning', the design of the healthcare facility must realistically consider the logistics of a functioning facility. It is essential that systems are in place which will inhibit the spread of infection and that resources and personnel are managed so they do not contribute to the risk of infection.

Examples of logistical issues to consider include:

- the delivery and distribution of materials and people via connecting corridors and lifts;
- the collection, transportation and storage pending removal or disposal of waste materials;
- clinical workflows.

- 9.50 These issues require careful planning and design which recognise the potential for infection spread through the mismanagement of such issues.

Sizing of space

- 9.51 At the time of writing this document, NHSScotland bed spacing requirements are under review. Bed spacing should be consistent with current guidance provided by Health Facilities Scotland (formerly NHSScotland Property and Environment Forum); Scottish Health Planning Note (SHPN) 04: 'In-patient accommodation: options for choice'.

- 9.52 There should be sufficient single rooms to prevent the spread of infection both to and from patients as a result of being 'housed' in open ward areas. Boards should audit use of single rooms to promote best use.
- 9.53 Initial planning and design in new builds needs to include numbers of beds and the appropriate space required between beds in accordance with the type of clinical intervention to be undertaken in the immediate patient environment.
- 9.54 Multiple beds in a single area should be kept to the minimum number possible, as this will assist in the prevention of cross-infection. Single rooms would appear to be the optimum solution, but other considerations such as cost and staffing levels may create pressure to reduce the proportion of single rooms.
- 9.55 Design, accessibility and space in patient areas all contribute to ease of cleaning and maintenance.
- 9.56 Spacing must take into account access to equipment around the bed and access for staff to hand-hygiene facilities. Sufficient space for equipment (e.g. hoists) is a health and safety issue for staff and patients.
- 9.57 Healthcare facilities must provide enough sanitary facilities and showers/bathrooms to ensure easy access, convenience and independence where possible.
- 9.58 Toilet facilities should be no more than 12m from the bed area or dayroom.
- 9.59 The work area around a patient needs to take account of the equipment which is nowadays routinely used in a healthcare facility and the patient space therefore needs to be sufficient to allow easy cleaning of that space and the equipment in it. Greater patient space may also reduce the risks of contact and airborne infection spread although the scientific evidence for this is limited. The design and planning needs to take account of current patient space guidance and the need to accommodate larger patients and patients requiring particular treatments/therapies and associated equipment.
- 9.60 Mode of transmission of infection should be taken into account when bed space and size of facility are being discussed. This includes direct transmission, indirect transmission via fomites (e.g. door handles, clothing, instruments, kidney dishes etc) and airborne transmission.
- 9.61 The principle should be to maintain sufficient space for activities to take place and to avoid transmission of organisms either by air or by contact with blood or body fluid or equipment. The exact space needed will vary according to numbers and activity of staff, type of patient, and environmental factors such as ventilation and humidity.

Particular issues for consideration include:

- patient groups;
- transmission of micro-organisms:
 - avoiding cross-infection;

- the environment and its role in cross infection;
- shared equipment;
- movement of patients.
- management of issues:
 - clinical pressures;
 - best use of single rooms;
 - avoiding unnecessary movement of patients between areas.

Bed density

- 9.62 With an increase in the prevalence of antibiotic-resistant bacteria and immuno-compromised in-patients, there is an increasing need for en-suite single rooms and negative or positive pressure isolation rooms.
- 9.63 Provision of isolation/single rooms used to segregate patients will help prevent the spread of micro-organisms, especially those transferred by the airborne route or those easily disseminated into the immediate patient environment.
- 9.64 The provision of adequate space around the bed can significantly improve the quality of the patient's experience and aid the clinical and healing process. Clinicians and carers need adequate space around the bed, arranged in a functionally suitable way, to undertake their work efficiently and safely, making the most effective use of resources. Facilities should also serve the psychological needs of patients and their families providing a place of safety and privacy.

Access for maintenance

- 9.65 Surfaces should be easy to clean and therefore should be free of internal corners, cracks, crevices etc. which would make cleaning more difficult.
- Ducting of services helps to achieve easy cleaning of surfaces but it is important to have sufficient, suitably sited access points for maintenance of the ducted services. The planning and design stage of the project must identify the access points for ducted services and those must be accessible with minimal or no disruption to the building surfaces or to patients.
- 9.66 Cleaning and maintenance of the ducts themselves must also be easily achieved with minimal infection risk.
- 9.67 There should be no ducted services where easy access is not available. Access for maintenance must not inhibit the safe efficient normal operation of the ward or department.

Departmental issues

- 9.68 There are some departments in a healthcare facility where infection risk is higher. These should be situated so as not to further increase the risk of infection.
- 9.69 For example, inappropriate transferring of cleaning equipment to different areas may be combated by use of colour coded/clearly labelled zoned areas where movement of domestic staff and equipment is controlled by swipe cards. Departments with susceptible patients should be located and serviced to minimise risk of contamination from departments where patients are an infection risk.

Storage

- 9.70 Adequate storage should be provided for patients' possessions, sterile supplies, non-sterile supplies or for domestic services equipment and patient care equipment. This can help limit the spread of infection of frequently handled items, minimising contamination. Separate storage areas may be needed depending on the kind of item being stored.
- 9.71 Inadequate provision of storage facilities can mean that inappropriate sites e.g. corridors and clinical areas, are used for storage of equipment. This can lead to unnecessary contamination both of equipment and, subsequently, from equipment.
- 9.72 Storage of Personal Protective Equipment (PPE) and ready access to clean PPE is important to encourage its use. There should be appropriate clinical waste bins for disposal of PPE once worn.

Patients

- 9.73 Lockers and wardrobes are intended for the storage of patients' personal possessions and clothing. They should be made of an impervious material that is easy to clean with no crevices or corners where dust or debris could accumulate, resulting in a reservoir for infectious agents. They should also be sufficiently robust to withstand the prolonged use of recommended decontamination agents. The lockers should be provided with castors to allow easy access for daily cleaning and castors should also be cleaned. Deep cleaning of lockers is required on a routine basis to ensure all surfaces including the underside of the locker are free from spillages. Further guidance can be found in the NHSScotland National Cleaning Specification produced by the HAI Task Force.

Domestic Services Room

- 9.74 Domestic cleaning equipment and supplies must be stored in separate purpose built areas. There must be a dedicated domestic services room and store for the provision of such must be adhered to (further assistance can be found in SHPN 40: 'Common Activity Spaces'). There should be sufficient space in these areas to allow cleaning equipment to be thoroughly cleaned after use.

The areas are required to have:

- good ventilation;
- adequate space for domestic staff to clean and decontaminate small pieces of equipment and furniture e.g. domestic and clinical waste bins;
- adequately sized rooms to accommodate all activities taking place in the area;
- non-slip safety flooring fitted with coving between the floor and the wall to prevent accumulation of dust and dirt in corners and crevices;
- a large sink with fitted worktops and splashback and a lockable cupboard;
- a separate hand-wash basin fitted with a mixer tap but without a sink plug and fitted with dispensers for soap, alcohol gel, hand towels and handcream;
- foot operated waste bins;
- wall protection around the area where the domestic cleaning equipment is stored;
- adequate provision for the storage of supplies;
- a door stay and door lock.

Linen cupboard

- 9.75 Each ward should have an area for the storage of clean linen, which in new builds should be purpose designed. The areas used for the storage of clean linen should ensure that linen is not exposed to contaminants.

The areas are required to have:

- good ventilation;
- adequate lighting;
- impervious flooring that is easy to clean and fitted with coving between the floor and the wall to avoid accumulation of dust and dirt in corners and crevices;
- slatted shelving to ensure free flow of air.

- 9.76 If linen trolleys are used to store linen within the ward area, they should be managed so that:

- they are kept tidy and closed to ensure that linen is not exposed to dust;
- linen bags are not left open or lying on the floor with the potential for exposure to dust, which may potentially carry micro-organisms;
- appropriate procedures are in place to allow cleaning of linen trolleys.

Soiled Linen Storage

- 9.77 The following types of linen should be segregated at source before sending to the laundry:
- used linen;
 - heat labile linen;
 - known or suspected infected linen, which should be placed in a water soluble bag before placing it in the linen bag.
- 9.78 The layout of laundry areas must be designed to ensure that high standards of cleaning can be maintained. Finishes to walls, floors, work surfaces and equipment must be capable of withstanding regular cleaning and the impact of mechanical cleaning equipment. The area should be large enough to allow access for decontamination trolleys.

Equipment Store

- 9.79 All healthcare premises require a storage area for large pieces of equipment such as beds, mattresses, hoists, wheelchairs and trolleys, which are currently not in use. Ideally this should be an equipment library with centralised storage, cleaning facilities and trained staff.
- 9.80 This storage area will not only protect the equipment from contamination and dust which may potentially carry micro-organisms, but also allow free access to floors and shelves for cleaning.
- 9.81 The layout of these areas must be designed to ensure that equipment is stored safely and securely to comply with manual handling requirements. The area should be fitted with good lighting and finishes to walls, floors, work surfaces and doors to protect against foreseeable mechanical damage; equipment must be capable of withstanding regular cleaning.

Waste Disposal

- 9.82 There are stringent legislative controls and clear working guidelines for the management of healthcare waste. Guidance on which can be found in SHTN 3: 'Management and disposal of clinical waste'. Good design can minimise problems with segregation, storage and disposal. Identification of categories and the means of segregation of clinical and special waste form the key elements of a waste disposal strategy. In addition, compliance with the National Waste Strategy (SEPA) is essential to reduce the volume of waste going to landfill. Consequently the recycling of Domestic Waste should be an integral part of the Healthcare Facilities Waste Management Strategy.
- 9.83 Space at ward level is needed for suitable waste containers for all types of waste generated, including recyclates.
- 9.84 Healthcare waste should be securely stored away from unauthorised personnel. Therefore any new developments, or upgrading, must include a secure disposal

store at the entrance of each ward or department, or, alternatively, provide a store to service a floor or area to facilitate safe segregation of all types of waste.

Waste Disposal Room

- 9.85 The waste disposal room is the temporary storage point for all items of supplies and equipment which have to be removed for cleaning, reprocessing or disposal, for example linen, central decontamination unit items, all types of waste and sharps.
- 9.86 The waste disposal room should be of an adequate size for all activities taking place within the area. Other requirements include:
- good ventilation;
 - non-slip safety flooring fitted with coving between the floor and the wall to prevent accumulation of dust and dirt in corners and crevices. The floor must be capable of withstanding regular cleaning and the impact of mechanical floor cleaning;
 - a large sink;
 - a separate hand-wash basin fitted with a mixer tap but with no sink plug and fitted with dispensers for soap, alcohol gel, hand towels and handcream;
 - wall protection on all walls and doors;
 - wall finishes which should be impermeable and easily decontaminated;
 - double door fitted with protective covering to allow easy access for secure and appropriate waste containers and an access control lock.

Cleaning facilities

- 9.87 Cleaning schedules must be prepared and in place and these schedules should take account of infection risk. Where building works are being carried out, the cleaning schedule may need to be reassessed. The cleaning schedule should be strictly adhered to and a nominated person should sign off satisfactory completion of the cleaning schedule. The cleaning schedule will identify cleaning which should be carried out after use, daily, weekly, etc.

Cleaning equipment

- 9.88 This will include:
- a range of equipment which must be in good working order and properly maintained including floor scrubbing machines, polishing machines, vacuum cleaning machines, etc;
 - sinks for cleaning equipment which should be exclusively for that purpose and should be large enough to adequately clean the pieces of equipment;
 - the provision of large sinks in areas where contaminated wastewater or blood or body fluids are disposed of.

Cleaning agents

9.89 The appropriate cleaning agents must be used. When choosing appropriate cleaning agents, various factors should be considered, for example:

- detergents loosen dirt and grease but do not kill bacteria;
- disinfectants kill bacteria;
- hot water and steam kill bacteria.

Laundry facility

9.90 Laundry facilities, whether ward based or centralised should provide;

- suitable space for laundry machinery;
- suitable storage for used linen and for separation of used and laundered linen;
- storage space which is designed to prevent odours from migrating from storage areas to adjacent areas;
- storage space designed to accommodate trolleys etc used in the transportation of linen;
- appropriate facilities to allow the segregation of used linen, heat labile linen and infected linen, in appropriate containers which are clearly identifiable;
- suitable facilities to allow compliance with hand hygiene practices;
- a laundry policy to ensure infection risks are minimised.

Changing facilities

Patient changing facilities

9.91 The increase in day case patients has increased the number of changing facilities required.

9.92 In areas such as out patients, imaging, day surgery, endoscopy and minor injuries units, it will be necessary to provide changing/storage facilities if clothing has to be removed and kept safe.

9.93 Flooring in these areas should be non-slip, easily cleaned and appropriately wear resistant. All surfaces must be able to withstand regular cleaning with both detergent and disinfectant products. All cubicle/screens must be able to withstand washing procedures at disinfectant temperature i.e. 3 minutes at 71°C or 10 minutes at 65°C.

9.94 All soft furnishings must be covered in an easily cleaned impervious material within all clinical and associated areas. Soft furnishings which are damaged should be removed for repair or disposal. The use of tape for repair is inappropriate. The fire resistance of furnishings and all fabrics must comply

with SHTM 87: 'Textiles and Furniture'. Cleaning processes should be developed to ensure that fire resistance is not compromised.

- 9.95 Hand-wash basins, sanitary facilities and showers should be provided in these areas.

Staff changing facilities

- 9.96 Changing facilities should be provided for staff to encourage them to change out of their uniform in the workplace. This is particularly important if the staff member is working in a clinical area or CDU. Facilities should be provided which allow staff to store their personal possessions safely. Locker sharing can reduce storage requirements.
- 9.97 Sanitary facilities and showers should be provided for male and female staff in these areas.
- 9.98 The distance from the working area may affect how often staff use the facilities. However, in the interest of the personal security and safety of staff, staff changing areas should be sited in the main area of the healthcare facility if not very close to (or within) the ward. Changing areas and showers should also be provided for staff who have become contaminated.
- 9.99 Staff should change from their outdoor clothing into their uniforms in the changing facilities provided.
- 9.100 By providing staff changing facilities with adequate areas for storage of clothing e.g. lockers, staff will be able to change from their staff uniforms into their outdoor clothing on site. This practice should encourage staff to travel home in their own clothes, not their uniform.
- 9.101 Staff must have easy access to a hand-wash basin and showering facilities in the event of a spillage, accident or contamination.
- 9.102 The Watt Group Report (2002) stated that specific guidelines and facilities (washing, showering and cleaning/changing uniforms) should be available in every hospital for the decontamination of staff who become grossly contaminated by blood or body fluids.

Maintenance Staff

- 9.103 Separate clothing should be provided for maintenance staff to change into when moving between clinical and non-clinical areas. Consideration should also be given to providing changing facilities for maintenance staff, service engineers etc who may have to change into scrub suits and dedicated footwear for work carried out in clean areas.

Uniform changing

- 9.104 Best practice suggests an area should be provided in staff changing where staff can order clean uniforms. In this area, staff should also be able to collect their

laundered uniforms and dispose of soiled uniforms for onward processing at the laundry.

Bed space area

Patient mobility

- 9.105 Patient mobility is considered vital for aiding recovery and maintaining physical health and hygiene. It is well understood that this helps reduce length of stay and physical complications in the recovery period.
- 9.106 The provision of sufficient space is essential for nurses and therapists to work, to accommodate wheelchairs and walking aids, and to assist the mobility of patients. Guidance on which can be found in SHPN 04: 'In-patient Accommodation: Options for choice'.

Clinical treatment

- 9.107 Many of the activities that previously took place in a treatment room now take place at a patient's bedside and therefore additional space is required for equipment and for clinical procedures to take place. It should be noted that treatment rooms may provide a cleaner environment in which less activity takes place during procedures.

Moving and handling

- 9.108 Moving and handling of patients is a major cause of back injury and other musculo-skeletal disorders amongst staff. To avoid such injury, patients should be moved using equipment designed specifically for the purpose. Sufficient space is therefore required to manoeuvre this equipment around the bed. Manual handling equipment can contribute to the transmission of micro-organisms if not adequately cleaned and stored.

Family support and visiting

- 9.109 Visits from family and friends are important for the well-being of patients. There should be sufficient space around the bed to allow for seating without disturbing patients in other bed spaces or the flow of nursing care. Adequate toilet facilities should also be in place to limit the risk of infection from visitors using the patient's en-suite facilities. Insufficient seating round the bed space area can lead to prevention and control of infection issues.

The Chief Medical Officer has introduced five tips for the public visiting patients in hospital to help in reducing cross infection. These are:

- think about keeping patients safe before you visit someone in hospital. If you, or someone you live, with has a cold or diarrhoea, or if you feel unwell, try to stay away until you are better;
- wash and dry your hands before visiting a hospital ward, particularly after going to the toilet. If there is alcohol hand gel provided at the ward door or at the bedside, use it;

- ask ward staff for advice before you bring in food or drink for someone you are visiting in hospital;
- if you visit someone in hospital, don't sit on their bed, and keep the number of visitors to a minimum at any one time. Never touch dressings, drips, or other equipment around the bed;
- if you think NHS premises are not as clean as they should be, let the Sister/Charge Nurse know. If you think a healthcare worker has forgotten to wash their hands, remind them about this.

Accessibility for staff

- 9.110 Poor access around the bed is stressful for staff who have to work, often under pressure, within limited space, entailing more potential for accidents, mistakes and delays. Moving and setting up equipment takes valuable time and this is hindered by limited space. Gaining access to bedhead controls and monitoring equipment also requires sufficient space.
- 9.111 In multi-bed areas there should be sufficient space around each bed for staff to carry out procedures without disturbing patients in adjacent beds and to provide a degree of auditory privacy. There is now a great deal more activity taking place at, or close to, the bedside which falls into three categories:
- clinical treatment and care;
 - personal care;
 - support duties including cleaning.

Cleaning

- 9.112 There needs to be space to allow the easy movement of beds and equipment to facilitate cleaning. Access for cleaning must be considered a key design factor for planners and architects designing new buildings or refurbishments.

Storage

- 9.113 Adequate space to store equipment away from the bed space is necessary, as inappropriately stored equipment can interfere with cleaning and create a reservoir for micro-organisms.

Fixtures and fittings

- 9.114 Fixtures and fittings should be easy to clean. Their design needs to take account of cleanability e.g. the surface material, access to all surfaces, etc. Complex dismantling to enable cleaning to be achieved is a disincentive to effective cleaning. Involvement of Domestic Managers in selection of fixtures and fittings is advised.
- 9.115 Fixtures and fittings should be movable as far as possible to ease cleaning.

Walls

- 9.116 Smooth, hard, impervious surfaces are recommended in clinical areas as they are easier to clean and bacteria cannot readily adhere to them (Bartley, 2000; Ayliffe et al, 1999). Design should ensure that surfaces are easily accessed, will not be physically affected by detergents and disinfectants and will dry quickly.

Ceilings

- 9.117 Smooth, hard, impervious surfaces are recommended in theatres and isolation rooms. Caution should be used when considering the use of ceilings to produce visually appealing areas as they can be difficult or time-consuming to access for cleaning, for example hidden lighting or box-work.
- 9.118 False ceilings may be associated with accumulation of dust or fungi and can harbour pests. It is therefore essential that buildings are checked on completion to ensure that no unwanted materials from the building works remain and that there is no access for pests (Ayliffe et al, 1999). Ceilings with removable tiles or perforated ceilings can allow dust to fall onto the area below during maintenance work. This type of ceiling should therefore be avoided in isolation rooms, operating theatres and treatment rooms (Ayliffe et al, 1999).
- 9.119 Pipes and cables running through walls above false ceilings should be sealed so far as is practicable.

Doors

- 9.120 All bays and single rooms used to segregate patients require doors if they are to be used for cohort nursing or isolation nursing. They should have smooth handles which can be easily cleaned, will not be physically affected by detergents and disinfectants and will dry quickly.

Windows

- 9.121 Windows, although not directly a prevention and control of infection issue, allow patients in isolation/segregation to feel less shut off from the world and have been shown to add to the therapeutic process where there is pleasant view.
- 9.122 Glass partitions, instead of solid walls, enable patients to see what is happening in the ward but there will also be a need to allow for patient privacy at times. Double-glazed windows with integral blinds are practical and solve a range of cleaning problems.
- 9.123 Windows in operating theatres, treatment rooms and isolation/segregation rooms should be fixed and sealed.
- 9.124 Avoid ledges as in cottage-style windows because this will allow for the accumulation of dust; ledges also require a significant cleaning commitment.

Radiators

- 9.125 Radiators have been implicated in outbreaks of infection with meticillin resistant *staphylococcus aureus* and are often difficult to clean because they are enclosed in bay windows or in protective covers to prevent burns. They should be smooth, accessible and cleanable.
- 9.126 Pipework should be contained in a smooth surfaced box that is easy to clean; pipework sited along a wall can become a dust trap and can be impossible to clean.
- 9.127 Pipes and cables running through walls above false ceilings should be sealed as far as is practicable.
- 9.128 Radiators should be smooth, accessible and easy to clean. Pipework should be boxed or enclosed with surfaces which are easy to clean.

Work surfaces

- 9.129 Surfaces should be designed for easy cleaning.
- 9.130 Surfaces near plumbing fixtures should be smooth, non-porous and water-resistant.
- 9.131 They should be free of fissures, open joints and crevices that will retain or permit the passage of dirt particles.
- 9.132 All joints must be sealed (Bartley, 2000).
- 9.133 Horizontal surfaces can become contaminated therefore regular cleaning is required.
- 9.134 All surfaces must be able to withstand regular cleaning with both detergent and disinfectant products.
- 9.135 Surfaces should be designed for easy cleaning, free of fissures, open joints and crevices. Surfaces should withstand regular cleaning with detergents and disinfectants. (Further guidance can be found in the NHSScotland National Cleaning Services Specification produced by the HAI Task Force.)
- 9.136 Internal corners should be coved. Horizontal surfaces not intended for storage e.g. tops of lockers, should be sloped.

Recommendations

- 9.137
1. The quality of finishes in all areas should be of a high standard. Guidance on the selection of finishes is provided in several SHTMs, SHPNs and SHBNs.
 2. Soft furnishings must be covered in an impervious material within all clinical and associated areas.
 3. Flooring should be easily cleaned and appropriately wear-resistant.

4. The use of carpets is not advised within any clinical or associated area. Attractive vinyl flooring materials are available which can provide aesthetic appeal.
5. All joints and crevices should be sealed.
6. Curtains must be able to withstand washing processes at disinfection temperatures.
7. Window blinds should be used with caution; the need for regular cleaning in clinical areas must be considered.
8. All surfaces should be designed for easy cleaning.
9. Smooth, hard, impervious surfaces should be used for walls.
10. All surfaces, fittings, fixtures and furnishings should be designed for easy cleaning and durability.

Equipment

- 9.138 The selection of equipment which can be easily decontaminated both internally and externally is critical. The use of soft 'difficult to decontaminate' fabrics should be avoided where possible. The design of equipment should also be considered, as intricate design details are often difficult to clean properly.
- 9.139 Equipment that is in direct contact with patients has been implicated in infection outbreaks (Irwin et al, 1980). Equipment that is within the immediate patient environment has been shown to be a potential source of cross-infection. Fixtures and fittings, if difficult to access or clean on a regular basis, fall into this category and must be included as a potential reservoir of infection when risk assessment is undertaken. Design should ensure that surfaces are easily accessed, will not be physically affected by detergents and disinfectants and will dry quickly.

Cleanability

- 9.140 Decisions about finishes, design, fixtures and fittings at the planning and procurement stages must take account of their cleanability, i.e. recognition of the importance of finishes etc being cleaned and kept clean. Finishes etc, which are difficult to clean are less likely to be properly cleaned and kept clean.
- 9.141 The quality of finishes etc in all areas should be of a high standard so that there is ease of cleaning and the fabric of the building stays intact and impervious over its life cycle.
- 9.142 Particular points to consider include the use of:
- hard flooring in clinical areas;
 - flooring which can be easily cleaned and is appropriately wear-resistant;
 - coving between the floor and the wall to make cleaning easier;
 - limited joints which should be welded or sealed;

- floor finishes, such as vinyl, which are impervious and can be easily cleaned;
- flooring which must be securely anchored. Lifting of the floor can create reservoirs of infection;
- surfaces such as wood, tiles and unsealed joints which should be avoided because they are more difficult to clean;
- flooring of a material which is unaffected by detergents and disinfectants;
- flooring in areas subject to traffic which, when wet, should have high slip resistance;
- carpets, these should not be used in clinical areas.

9.143 The use of dividers or screens that can be manoeuvred on wheels can be of benefit in ITU areas. The use of these dividers requires consideration at the planning stages as extra space is required both for their use between beds and for storage. It is also important that they are easily cleanable.

Electrical supply

9.144 Guidance on the supply of electricity can be found in SHTM 2007: 'Electrical services: supply and distribution'. If the ventilation system is used to control airflows to minimise cross infection, this system should be on a dedicated power supply which is clearly marked and designed to avoid accidental isolation. Where practical, power supplies should be classed as essential.

Electrical power services and sockets

9.145 Sufficient 13-amp switched and shuttered socket outlets should be provided in corridors and in individual rooms to enable domestic cleaning appliances with flexible leads (9 metres long) to operate over the whole department.

9.146 Where possible, socket outlets should be flush-mounted or in trunking systems to prevent the build up of dust.

Ventilation

9.147 In specialised applications such as isolation rooms or decontamination facilities, it is important to be able to monitor the effectiveness of the ventilation systems by means of visual indication such as pressure gauges. Where visual indication is provided, it is essential that the procedures for checking and recording the reading, if necessary, are clearly laid down and staff are adequately trained in the operation of the system and action to be taken in the event of system failure.

9.148 Isolation rooms which have a ventilation system capable of providing either positive or negative pressure within the room are not generally recommended. This is because investigations of failures of such systems have identified lack of staff awareness of the purpose and functioning of the system as key factors.

- 9.149 Guidance on the use of ventilation systems is given in SHTM 2025: 'Ventilation in Healthcare Premises' and Scottish Hospital Planning Note 13: 'Sterile services department'.
- 9.150 Consideration should be given to room layouts and the relationships between rooms and should be such that they avoid cross infection. Similarly, so as to avoid cross infection, Domestic Services Room (DSR) and service rooms should be located away from clinical or patient areas and extract outlets should be directed away from air intake vents.

Hot and cold water supplies

- 9.151 Guidance on hot and cold water supplies can be found in SHTM 2040: 'The control of legionellae in healthcare premises: a code of practice' and SHTM 2027: 'Hot and cold water supplies: storage and mains services'. Guidance on water filtration can be found in SHTN 2: 'Domestic hot and cold water systems for Scottish Healthcare premises'. Safe and effective hot and cold water supplies are paramount in healthcare premises to maintain a safe and comfortable environment for patients and staff, and for treatment at all levels of clinical and surgical care. Water must be supplied at an appropriate temperature and pressure, for example:
- water being supplied to hand-wash basins, baths etc should not cause scalding of the user;
 - water being supplied to the DSR and or Pantry should be at a higher temperature however these need to be clearly marked as providing "VERY HOT WATER";
 - systems should be designed to ensure continued circulation of water where practical;
 - systems should be insulated to avoid heat transfers from hot supplies to cold;
 - dead legs in pipework should be avoided;
 - consideration should be given to the space and plumbing required for chemical treatment of water systems e.g.
 - compatibility of chlorine dioxide treatment;
 - the necessity for reverse osmosis plant in renal dialysis or sterile supplies units;
 - careful consideration should be given to the frequency of use of fixtures especially where infrequent use may result in legionella control problems e.g. showers, sinks, long pipe runs.
- 9.152 Contamination of the water supply has been recorded as a cause of disease and death in both the public health arena and the hospital setting. It is important, therefore, that drinking water in healthcare settings is safe, readily available to patients and is palatable to encourage drinking. The new EU Drinking Water Directive, which is transposed into UK law by the Water Supply (Water Quality) (Scotland) Regulations 2001, contains new provisions to ensure

that the drinking water supply within buildings to which the public has access remains wholesome and is not adversely affected by the domestic plumbing system.

- 9.153 Access to chilled water, which is plumbed directly off the mains, may be important when patients are feeling unwell, pyrexial or the ambient temperature is high. Patients who are ill become dehydrated and may need to increase their fluid intake.
- 9.154 A plentiful supply of water for other uses such as personal hygiene, hand hygiene and cleaning of the environment and equipment is also needed. Storage of this water requires careful consideration and can present problems if not dealt with appropriately.
- 9.155 Systems employed in the storage and conveyance of water for human consumption, and or use, should be designed and installed in order that the growth of harmful organisms, and hence the risk to people, is minimised.
- 9.156 Systems must incorporate measuring devices to monitor salient parameters accurately and allow trend logging to demonstrate the efficiency and sufficiency of the control measures employed. The number, type and location of the measuring devices should provide data that is representative of the whole system. Whilst it is desirable to increase the availability and access to drinking water and hand hygiene appliances, the provision of such must not encourage the incidence of water within sections of systems which may have a tendency to stagnate. Low flow and no flow of water within systems particularly where temperature variation may occur as a result, must be minimised as far as reasonably practicable to ensure the conditions that will encourage the growth of harmful organisms are avoided as far as possible.

Storage of water and policies for maintenance

- 9.157 Many organisms, such as species of nontuberculous *Mycobacteria*, *Pseudomonas* and *Legionella*, have been isolated from hospital water systems. Guidance on the control of *Legionella* in water systems can be found in the Health & Safety Executive's approved Guidance Note L8: 'Legionnaire's disease: the control of *Legionella* bacteria in water systems' and SHTM 2040: 'The control of legionellae in healthcare premises - a code of practice'. Problems associated with *Legionella* have been documented in healthcare premises however these problems have been minimised by:
 - cleaning water storage tanks;
 - maintaining a consistently high temperature in hot water supplies or introducing a form of online disinfection such as chlorine dioxide or ionisation if lower temperature hot water is used to avoid the need for thermostatic mixing valves (see Health & Safety Executive L8, Scottish Health Guidance Note 'Safer' Hot Water and Surface temperatures and SHTM 2040: 'The control of legionellae in healthcare premises - a code of practice');
 - regular maintenance of plant;

- removing plumbing dead-legs;
- keeping cold water systems cold;
- minimising water storage.

- 9.158 In large hospitals, storage tanks are often necessary to ensure adequate supplies of water. Findings of *Aeromonas hydrophila* in seasonal trends by Picard and Goullet (1987) suggests that monitoring the water supply, especially during the summer months, is valuable. They also discuss the importance of keeping storage tanks clean and designing storage facilities to minimise excessive cold water temperatures, which should then reduce the tendency for multiplication of not only *A. hydrophila* but also *Legionella spp.*
- 9.159 Good practice requires that hot and cold water pipework are separated (i.e. not in the same ducting) to a sufficient margin to avoid heat transfer to the cold water supply. Hot and cold water pipes should not be installed in the same space e.g. voids or ducts where a sufficient margin of separation cannot be provided between pipes to prevent heat transfer. It has also been suggested that there is a need for testing, following a survey of bacteriological quality of water from hospitals by Hunter and Burge (1988).
- 9.160 Guidance on hot and cold water systems can be found in SHTM 2027: 'Hot and cold water supply, storage and mains services'.

Provision of single room facilities

- 9.161 With an increase in the incidence of antibiotic-resistant bacteria and immuno-compromised in-patients, there is an increasing need for en-suite single rooms and negative or positive pressure isolation rooms. Single rooms with en-suite facilities allow for easier management of infection than wards. The current trend is for new facilities to have more single rooms than previously with some parts of the UK planning on a basis of at least 50% single rooms. Provision of isolation/single rooms will help prevent the spread of organisms, especially those transferred by the airborne route or those easily disseminated into the immediate patient environment. En-suite single rooms also provide greater privacy and are preferred by many patients.
- 9.162 Many patients with an infection require physical isolation. However, often patients cannot be isolated because of a shortage of single rooms and isolation rooms. The key to effective isolation on acute general wards is the provision of single rooms with en-suite sanitary facilities. Single rooms reduce the risk of cross-infection for both non-airborne and airborne diseases and help to lower the incidence of HAI. Most patients on acute general wards can be isolated/segregated in single rooms with en-suite facilities. All single rooms in new-build hospitals should have en-suite facilities so that they can, among other reasons, be used to isolate/segregate patients.
- 9.163 Historically, isolation/segregation in general wards has been provided in single rooms, sometimes without en-suite facilities. Rooms without en-suite facilities often cannot be used to isolate patients effectively.

- 9.164 Ventilated isolation suites with en-suite facilities can also be provided. They may have a ventilation system that provides a positive pressure in the room to protect the patient from infection, or a negative pressure to prevent a patient from infecting others, or the ventilation may be switchable from positive to negative. These rooms rely on staff being able to assess the type of ventilation required when a patient arrives on the ward and, for switchable systems, knowing how and when to select the correct ventilation mode. Patients can be put at risk if the ventilation mode is not set correctly and as such the provision of isolation rooms which are switchable from positive to negative air pressure is no longer recommended because of the risk to people inside and outside the room in the event of the setting being incorrect.
- 9.165 There are four main reasons for caring for patients in single rooms:
- patient susceptibility to infection from other sources;
 - patient presents an infection risk to others;
 - non-medical, for example patient preference;
 - clinical but not infection-related.
- 9.166 In terms of infection control, only patients in the first two categories require isolation. Patients in the latter two categories can be cared for in standard single en-suite rooms used to segregate patients. In order to simplify the use of isolation facilities, two room designs for isolating patients in acute general settings are discussed:
- single room with en-suite facilities;
 - enhanced single room with en-suite facilities and ventilated anteroom (isolation suite).

Single room with en-suite facilities

- 9.167 A single room with en-suite sanitary facilities having extract ventilation is a simple, cost-effective way to provide isolation/segregation and will meet the needs of most patients on general wards. The room does not require any specialist knowledge or action by the nursing staff to operate it. When not being used for isolation the room can be used for general nursing.

Enhanced single room with en-suite facilities and ventilated lobby (isolation suite)

- 9.168 An enhanced single room with a positive pressure ventilated entry lobby and en-suite facilities with extract ventilation provides both source and protective isolation. The positive pressure lobby ensures that air from the corridor does not enter the isolation room, and that air from the room does not escape into the corridor. This simple design enables the suite to be used for either source or protective isolation without the need for switchable ventilation or special training for staff. It also provides safe isolation/segregation for patients whose condition is unknown.

Advantages

- 9.169 Both rooms are suitable for caring for patients not in isolation but who require a single room for other reasons. In addition, both room designs are simple in concept, safe in operation, and do not require the nursing staff to have any specialist ventilation knowledge.
- 9.170 On occasions, it may be necessary to prioritise the use of the available isolation and single rooms used to segregate patients. In such situations, consideration must be given to cohort nursing of patients within small 2/4 bed bays.
- 9.171 The focus of single/isolation rooms discussed in this part of the document include:
- the role of isolation/single rooms in preventing cross-infection;
 - cohort nursing;
 - quantity and design;
 - negative/positive isolation rooms;
 - hand-hygiene facilities;
 - sanitary facilities;
 - storage of personal protective equipment;
 - size and layout;
 - visibility/location;
 - furnishings and fixtures;
 - finishes;
 - floors;
 - walls;
 - ceilings;
 - doors;
 - windows;
 - engineering requirements.

The role of isolation in preventing cross-infection

- 9.172 The primary aim of prevention and control of infection is to prevent the spread of infection between patients, visitors and staff by the control or containment of potentially pathogenic organisms. Many of these organisms can be controlled by basic prevention and control of infection practices such as hand-hygiene and environmental hygiene, but isolating/segregating the source patient can only effectively contain certain organisms.
- 9.173 'Negative pressure' isolation rooms are essential for infections transmitted by the airborne route: it has been reported that isolation of infected patients

prevents cross-infection in outbreaks of tuberculosis (Louther et al, 1997). For other infections, a patient can be accommodated in a single room which can segregate the patient.

Cohort nursing

- 9.174 When an index case of infection is followed by several secondary cases, it may be necessary to cohort nurse a group of patients in a bay if insufficient single rooms are available. This can be more easily achieved where wards are divided into small bays (two or four beds per bay) which can be isolated/segregated further by closure of doors at the entrance/exit and which also have en-suite facilities. When prevention and control of infection guidelines are adhered to, research has demonstrated that cohort nursing can successfully control and contain infection in hospital (Cartmill et al, 1994; Zafar et al, 1998; Green et al, 1998; Karanfil et al, 1992; CDC, 1995, 1997).
- 9.175 There is currently no definitive guidance on size, ventilation or the equipping of isolation rooms. NHSScotland SHPNs for relevant departments such as wards, theatres and other specialised areas and SHTM 2025: 'Ventilation in healthcare premises', give advice on natural ventilation, general extract ventilation and ventilation for specialised areas.
- 9.176 Experience has shown that many hospitals find the present allocation of isolation/single rooms inadequate to deal with the increasing numbers of infected and immuno-compromised patients (Langley et al, 1994; Wiggam and Hayward, 2000). Hospitals with 10% of their bed contingent as single rooms often find that this number is inadequate to cope with every infectious patient. Where this is the case, risk assessment needs to be used to inform decisions regarding which patients to nurse in single rooms.

Hand-hygiene facilities

- 9.177 Hand-hygiene and the use of Personal Protective Equipment (PPE) are key to preventing the spread of infection. Sufficient hand-wash basins must be supplied in a room used to isolate patients (and attached ante-room) and single room. This is in addition to the basin provided for patient wash facilities. Elbow taps for clinical hand-wash basins are preferred and the touch-free control of water flow will further aid the control of infection, although maintenance implications need to be considered.

Sanitary facilities

- 9.178 Personal hygiene contributes to the prevention of cross-infection and is improved if patients have their own bath or shower, WC and hand-wash basin. Single rooms should therefore be provided with en-suite sanitary facilities. An en-suite single room should also be able to accommodate a hoist for lifting patients.

Size and layout

- 9.179 Additional facilities may be required for the care and treatment of patients in isolation rooms/single rooms, especially if the isolation is likely to last for some time. The facilities required may include the storage of:
- supplies retained in the room;
 - personal clothing and possessions;
 - essential domestic cleaning equipment held in en-suite sanitary facilities.
- 9.180 Where possible, the opportunity should be taken to size the room so that the bed can be placed parallel to the external wall, thereby allowing the patient to enjoy a view of the outside. An intercommunication system, while not essential, is desirable as this allows the patient verbal contact without compromising their isolation.

Visibility/location

- 9.181 If patients are to stay in an isolation/single room or bay, it is important that they are able to see staff from their beds. Staff should also be able to see the patient in case of an emergency. This reduces the psychological problems of isolation/segregation. Providing outside views using windows with low sills can also reduce the sense of containment.

Furnishing and fixtures

- 9.182 In isolation/single rooms/small bays where infectious patients are nursed, it is important that there is enough space to easily clean furnishings and fixtures.

Finishes

- 9.183 Ledges, recesses and tight angles where dust particles can be trapped should be avoided to allow ease of cleaning. It should be ensured that detergents and disinfectants will not physically affect surfaces and that they will dry quickly.

Floors

- 9.184 Carpets are not advisable in isolation/single rooms as carpets may prolong the survival of certain micro-organisms.

Walls

- 9.185 Wall finishes should be impermeable and easily wiped over if necessary.

Ceilings

- 9.186 These should have homogeneous plastered surface with flush-mounted recessed lights, ventilation grilles and other ceiling fixtures, where possible. Removable ceiling tiles in a grid layout are not advised for isolation rooms.

Doors

- 9.187 The corridor door to the room should be one and a half leaf and contain a large vision panel. A means of obscuring the vision panel should be included within the door.
- 9.188 Doors should have smooth handles which can be easily cleaned, will not be physically affected by detergents and disinfectants, and will dry quickly.

Windows

- 9.189 These will need to be lockable when the specialised ventilation is turned on. Curtains to provide privacy should be controlled within the room.

Engineering requirements for isolation rooms

- 9.190 Provision of mechanical ventilation systems is important in controlling the required direction of air movement between isolation rooms and the adjacent corridor.
- 9.191 For negative pressure isolation rooms, there should be a readily visible monitor independent of the air supply/extract system. This is best achieved by monitoring the pressure differential between the patient room and corridor or lobby. This differential should preferably be monitored continuously, i.e. a pressure sensor linked to an alarm at the nurses' station should the pressure drop below a pre-set limit. The alarm should have a built-in delay of a few seconds so that it does not activate every time the door is opened. For negative pressure isolation rooms, there should be an interlock system such that supply ventilation is cut off if the extract ventilation fails. There should be a clear indication to users that the ventilation has failed.
- 9.192 For isolation rooms with both negative and positive pressure ventilation, the mechanism for switching from one to the other should be lockable. As mentioned previously, it should be noted that this option of having isolation rooms with switchable ventilation is not generally recommended as infections have been transmitted through patients being cared for in a positive pressure room when they should have been in a negative pressure room. Staff should be properly trained on how to use the mechanism. With regard to the en-suite sanitary facility, the extract ventilation should be designed to work in conjunction with the main ventilation system.
- 9.193 General space/heating requirements can be met by the same method as for 'standard' single rooms. Care should be taken in selection of the heat emitter, as it needs to be easily cleaned and should not have inaccessible corners.
- 9.194 To reduce dust contamination and ease cleaning, luminaires should be recessed, dust-excluding and fully accessible from below.
- 9.195 Planned maintenance and monitoring programmes must be established for ventilated rooms to ensure the design criteria is maintained and met at all times. Although it is impossible to give specific maintenance frequencies, each unit

must be included in a planned preventative maintenance schedule that includes pressure/air flow monitoring equipment.

Hand-hygiene facilities

Clinical Sinks

- 9.196 Hand-hygiene is the single most important factor in the prevention of healthcare associated infection (Ayliffe et al, 2000).
- 9.197 It is known that compliance with hand-hygiene guidelines have led to a significant reduction in the carriage of potential pathogens on the hands and can result in reduction of patient morbidity and mortality from hospital acquired infection (Pittet et al, 2000).
- 9.198 The absence of conveniently placed sinks often leads to non-compliance with hand hygiene guidelines. Good departmental design, with sufficient, appropriately placed hand-wash basins can increase compliance.
- 9.199 Thus, the importance of facilities to encourage hand hygiene should be high on the list of priorities when designing and planning new healthcare premises or refurbishment of existing premises is being undertaken.
- 9.200 This part of the document discusses:
- design;
 - sink provision;
 - water/taps;
 - hand-hygiene dispensers;
 - hand drying.

Design

- 9.201 Sinks in clinical areas must be suitable for that purpose (not of a domestic design). Hotel-style sinks are not appropriate.
- 9.202 The dimensions of a clinical sink must be large enough to contain splashes and therefore enable the correct hand-hygiene technique to be performed (Bartley, 2000).
- 9.203 The sides of the sink should be curved to prevent splashing.
- 9.204 Hand-wash sinks should be sealed to the wall or placed sufficiently far from the wall to allow effective cleaning of all surfaces.
- 9.205 Waterproofed sink splash-backs should be included to prevent wall damage and allow ease of cleaning (Ayliffe et al, 1999).
- 9.206 Clinical sinks should not have a plug or a recess capable of taking a plug. A plug is an unnecessary source of infection (especially *Pseudomonas* spp.) and

can discourage staff from washing their hands under running water, particularly if mixer taps are not available.

- 9.207 Overflows are difficult to clean and become contaminated very quickly, serving as reservoirs of bacteria. They should therefore be avoided (SHPN 04: 'In-patient accommodation – options for choice').

Sink provision

- 9.208 Hand hygiene facilities must be readily available in all clinical areas. There must be sufficient sinks to encourage and assist staff to readily conform to hand hygiene protocols (Boyce et al, 2000; Feather et al, 2000; Carter and Barr, 1997; Dancer, 1999; Department of Health, 2000; Harris et al, 2000; Larson and Killien, 1982; Pittet, 2000). Inconveniently located hand hygiene facilities are one of the main reasons that healthcare staff do not comply with hand hygiene protocols (Larson and Killien, 1982; Pittet, 2000).
- 9.209 There is a need to review the numbers and placement of sinks, as well as their dimensions (Kesavan et al, 1998; Bartley, 2000). Guidelines for the appropriate numbers of sinks in clinical areas have been identified (SHPN 04: 'In-patient accommodation - options for choice'). This guidance suggests a minimum of one sink per single room or small ward area and one sink per six beds in a large multi-occupied room. However, to encourage good practice and give reasonable access, it is recommended that there should be:
- ideally, in **intensive care and high dependency units (critical care areas)**, one hand-wash basin at the front of each bed space;
 - one sink between four patients in **acute, elderly and long-term care** settings; and
 - one sink between six patients in **low-dependency** settings, for example mental health units and learning disability units.
- 9.210 In **primary care** and **out-patient** settings where clinical procedures or examination of patients/clients is undertaken, then a sink must be close to the procedure, ideally in the same room or in a cubicle section of the room.

Water/taps

- 9.211 Health and safety regulations (The Workplace [Health, Safety and Welfare] Regulations, 1992) require that both hot and cold running water should be available in areas where employees are expected to wash their hands.
- 9.212 Hands should always be washed under running water; mixer taps allow this to be practised in safety in healthcare settings where water temperatures are high to combat *Legionella* spp.
- 9.213 Taps should be elbow, knee or sensor-operated (SHPN 04: 'In-patient accommodation - options for choice') for hand hygiene.

- 9.214 Taps should be easy to turn on and off without contaminating the hands. Infrared taps are an alternative but these are expensive and can pose problems with cleaning and flushing (Bushell, 2000).
- 9.215 Taps discharging into a shallow sink or directly into a drain hole can cause splashing which disperses contaminated aerosols. Thus, the tap outlet flow should not point directly into the sink outlet (Ayliffe et al, 2000).
- 9.216 Swan-neck tap outlets must not be used, as they do not empty after use. Strainers and anti-splash fittings at outlets should not be used as they easily become contaminated with bacteria.

Hand hygiene dispensers

- 9.217 Skin disinfectants and soaps must be wall-mounted near the sink so that the user can operate the dispenser properly without risking contamination. Soap dispensers should not be refillable but be of a disposable, single cartridge design.

Alcohol based hand rubs

- 9.218 Alcohol-based handrubs have an important role, especially when access to hand-wash basins is difficult (Pittet, 2000). Unlike soap dispensers, these do not necessarily have to be placed by sinks. Alcohol based handrubs are a key aid in the prevention and control of infection. It is recognised that these materials are highly flammable and an appropriate fire risk assessment should be carried out with consideration given to the storage of these products. Ingestion of the product by certain patient groups has also been reported. The National Patient Safety Agency in England (2004) has stated that personal dispensers should be used where there is an increased likelihood of patient ingestion. Risk assessment should be carried out on the use of alcohol based handrubs, the location and size of dispensers and the storage and disposal of new stock, giving consideration to the likelihood of ingestion especially in high risk ward areas and clinical units.

Hand drying

- 9.219 Hand drying is of equal importance in maintaining hand hygiene as wet surfaces can transfer micro-organisms more effectively.
- 9.220 Paper hand-towels dry hands rapidly and dispensers can be used by several people at once. They are considered to be the lowest risk of cross-infection and are the preferred option in clinical practice areas (Bushell, 2000). The dispensers should be conveniently placed by hand-wash sinks.
- 9.221 The use of paper towels in rolls should be discouraged. They are difficult to tear off without contaminating the remaining roll (Gould, 1994; Hoffman and Wilson, 1994).
- 9.222 To discourage the use of reusable towels, towel rails should not be installed next to clinical hand-wash basins. Fabric towels are recognised as a source of

cross contamination and are not recommended in clinical practice (Blackmore, 1987).

- 9.223 Hot-air dryers should not be used in clinical areas as warm air currents dry hands slowly and can be used by only one individual at a time. This results in queues and the temptation to dry hands on clothing (Bushell, 2000).
- 9.224 Foot-pedal-operated bins with a waste bag should be provided by each clinical hand-wash basin (Gould, 1997).
- 9.225 A minimum of one hand-wash sink in each single room is required. En-suite single rooms should have a hand-wash basin in the en-suite facility in addition to a clinical hand-wash basin in the patient's room.
- 9.226 Isolation rooms/single rooms used to segregate patients should have a hand-wash sink in the ante-room, isolation room and en-suite facilities.
- 9.227 Ideally, in intensive care and high dependency units (critical care areas), consideration should be given to providing one hand-wash basin for each bed space.

Catering/food hygiene

- 9.228 There are many important requirements to be considered when planning a new catering facility, whether this is a new build or an upgrade of an existing building. In the planning and design of such a facility it is essential that professional input is obtained from a number of sources, particularly the Local Environmental Health Office, NHS Infection Control, Health & Safety.
- 9.229 It is important that the following areas are considered:
 - the size of the facility must first of all be established and this is generally based on the estimated daily production requirements (size should be 'fit for purpose' and not restricted by the space available);
 - style of food production and service to be used e.g. cook/serve, cook/chill, bulk or plated service. The patient type and layout of the hospital site can heavily influence this decision and will assist in the choice of equipment.
- 9.230 To enable ease of maintenance, the general fabric of the internal building should be given careful consideration with suitably finished surfaces for floors and walls. Consideration should be given to the following:
 - general ventilation is a key factor to be considered including environmental temperatures of workspace;
 - the design should be based on a logical flow pattern for production and service e.g. goods inward > checking and storage > preparation > production > service/distribution > returns > etc;
 - safe holding and handling of food requires careful consideration when designing refrigeration/chilling/freezing requirements;

- satisfactory facilities must be made available for catering staff changing in accordance with guidance (e.g. HBN 10: 'Catering department'. Comments on use in Scotland can be found in SHHD/DGM 86/43), with specific planned arrangements for hand hygiene both prior to entering and whilst in the catering/food handling area;
- to aid compliance with the relevant Food Safety Legislation, a competent Hazard Analysis and Critical Control Point (HACCP) system must be developed. This should be developed in conjunction with the Local Environmental Health Department;
- attention should be given to planning for adequate segregated storage capacity e.g. chilled foods, raw, cooked, dry goods, dairy foods, disposable goods, cleaning materials, waste material awaiting uplift, etc;
- in the area of preparation facilities, attention must also be given to segregated temperature controlled areas particularly for chilled food handling.

9.231 Patients can be particularly vulnerable to the effects of food-borne infection.

This is usually traced to a bacterial source and problems can arise from contamination from food handlers, utensils and work surfaces as well as incorrect or inadequate food hygiene precautions. It is important that management control systems, for example HACCP (Hazard Analysis and Critical Control Point): see the Department of Health's (1993) 'Assured safe catering – a management system for hazard analysis', good practices and the conditions in which the food is stored, prepared, processed, distributed and served all enable high standards of hygiene to be achieved and readily maintained.

9.232 To facilitate appropriate standards of personal hygiene for staff, there should be hand-wash basins in each preparation area and in the cooking and serving areas. Non-touch taps should be specified, and liquid soap and paper towels should be provided. Basins should be sited where they cannot splash onto food preparation equipment.

9.233 Once a decision has been taken on the style of cooking and service to be adopted, consideration should then be given to equipment choice. It is essential that equipment is chosen which will facilitate ease of cleaning, with mobility being a feature wherever possible.

9.234 Equipment selection should be carried out with as much research as possible into the technology available. Key features to take account of when planning equipment selection include:

- carefully specify requirements;
- use National Contracts available;
- carry out detailed tendering process with realistic time-scales;
- budget for preventative maintenance contracts for all production and service equipment, with particular emphasis on the ability of the equipment to maintain acceptable food temperatures during transit. Plan to include spare

capacity in the stock of trolleys in order to allow for breakdown and removal from service for maintenance and cleaning.

Ward kitchens, pantries and therapeutic kitchens

- 9.235 Equipment purchased must conform to the standards in the Food Safety Act 1990 (Scotland). This includes the need for a separate hand-wash basin and finishes used for the floors, walls, etc. The size and design will vary according to the overall decision for food preparation in the premises. If a cook-chill system or regeneration of frozen food is to take place, the kitchen will need to be larger to house the regeneration oven and will need additional ventilation.
- 9.236 Catering facilities at ward level require careful consideration. During the course of the day, a wide range of catering procedures will take place in the ward kitchen/pantry areas. These procedures are normally carried out by either nursing or domestic services staff with the majority of the tasks carried out relating to the preparation of 'between meal' snacks and beverages and the washing up of crockery, cutlery and glassware. The ability to be able to maintain a clean environment is of paramount importance and the ward kitchen should be designed to facilitate this.
- 9.237 Space required will vary according to the number of beds which the facility will serve and the style of food service will also dictate the space required. e.g. bulk food service or plated meals. A bulk food service may require crockery from all meals to be washed at ward level whilst the plated service will normally see crockery from the three main meals returned to the main hospital kitchen for wash-up, with only between meal snacks and beverage crockery washed at ward level. The ward kitchen should be designed to allow sufficient space to allow a number of staff to work in the area at the same time and to accommodate the required level of storage and equipment.
- 9.238 The ward equipment to be selected should be of industrial standard to ensure that it is capable of dealing with the heavy demands made on it. Domestic type appliances should be avoided, particularly refrigerators, ice-making machines, dish-wash machines and hot water boilers. Advice from the Infection Control Team should be sought prior to the purchase of equipment.

The following points should be complied with:

Refrigerators: The size of the unit selected should be capable of holding the routine daily supplies. This will be influenced by whether or not a 'pergal' milk dispenser is used in the kitchen or if the refrigerator is required to hold quantities of carton milk. An industrial unit will be more capable of handling the larger quantities of chilled food with a more effective recovery time for chilling of the unit given the frequent opening of the door and loss of temperature. The unit selected should be capable of maintaining a chill temperature of below 4 degrees centigrade.

Dish-wash machine: As with the refrigerator, this should be of industrial standard with the ability to achieve a rinse temperature of 82°C. The machine should also be capable of operating with an automatic dosing system of wash

and rinse products. Storage facilities should also be provided for safe keeping of the wash and rinse products.

Ice-making machine: The type selected should be capable of automatic dispensing of ice and without a storage reservoir, which requires the users to scoop ice from a stock which may have been made too far in advance. Ideally they should be plumbed from the mains water supply to ensure biofilms are minimised.

Hot water boilers: A thermostatically controlled water boiler should be provided for the preparation of beverages in preference to the use of kettles, particularly in kitchens that supply a service to a ward area.

Microwave: If sited in the ward area, should not be used to cook or reheat food intended for consumption by patients.

- 9.239 Sufficient storage facilities should be provided to accommodate the range of food and non-food supplies held at ward kitchen level. This is normally held in base storage units and wall mounted cupboards with adequate provision of standard height work-surfaces. Attention must be given to establishing sufficient numbers of electrical sockets to accommodate electrical equipment.
- 9.240 The general environment should contain adequate levels of ventilation to handle the heat and steam generated by the main kitchen equipment. The floor surface should be easy to clean and preferably of a high slip-resistance. Walls and other surface should be impervious for ease of cleaning.

Occupational Therapy kitchens

- 9.241 In some hospitals, dedicated kitchen areas are required for use by Occupational Therapy staff for the rehabilitation of patients. The most important factor to consider for these areas is that they should simulate as closely as possible the kitchen conditions found in a standard household environment. However, the need for ease of cleaning, repair and maintenance is a priority.
- 9.242 The space required will vary from single to multi-use and this requires to be established by consultation with Occupational Therapy staff. Adequate provision should be made for ease of access, taking into account space for patients in wheelchairs and with walking aids. The layout of work-surfaces etc should be decided in consultation with the Occupational Therapist.
- 9.243 In terms of equipment, the kitchen should be fitted with the normal range of kitchen appliances and these should be of normal domestic size and not industrial specification. These include both electric and gas cookers with oven, microwave oven and fridge. Occupational Therapy staff should be consulted to determine the need for any other items of fixed equipment. Provision should also be made for sufficient numbers of electrical sockets (at worktop level) to accommodate the use of additional kitchen appliances such as toasters, mixers/blenders, kettles, etc.

9.244 The general environment should be to a standard that will facilitate ease of cleaning with no provision for curtains or carpets. The floor surface should be of vinyl with an impervious wall finish and appropriate ventilation in the cooking area. The facility should also be well fitted with a range of domestic type kitchen cupboards, worktops and wall mounted storage units. The level required should be determined by consultation with Occupational Therapy staff.

10. Construction/Refurbishment Stage

Introduction

- 10.1 During the construction or refurbishment of facilities, a range of circumstances prevail which present significant problems and opportunities in terms of prevention and control of infection. It is also at this stage where lifetime prevention and control of infection problems can either be built in or out depending on the profile and resources given to prevention and control of infection issues. This Section considers the main issues and highlights actions to minimise infection risks during and after the construction phase.

Construction and waste

- 10.2 Each year in Scotland approximately 6.28 million tonnes of waste are produced by the construction industry (SEPA 2000) and for projects attached to existing healthcare facilities this can cause considerable risk to susceptible patients due to increased risk of fungal spores being released into the air. It is important that this dust and debris is controlled and disposed of safely. Major earthworks are also a recognised factor in legionella infections.
- 10.3 Barrier systems should be erected and fit-for-purpose closed waste containers supplied.
- 10.4 Waste produced by the construction industry relating to projects at healthcare facilities, can give rise to infection problems, especially for susceptible patients, and careful planning is required if the potential for infection risk is to be designed out.
- 10.5 The clinical implications which arise when the system for managing construction waste goes wrong, or is simply not in place, include increased risks to immunocompromised patients from incorrect transporting and disposal of the waste.

Methods of control

- 10.6 Construction work in a healthcare facility inevitably generates dirt and dust and with it certain micro-organisms which have the potential to harm immunocompromised patients. This is especially true of *Aspergillus fumigatus*, a ubiquitous fungus which is spore producing and which is transmitted by inhalation or contact. Dust and debris control is essential along with the need for increased and regular cleaning during and after completion of the building project.
- 10.7 Designated entry and exit areas should be identified for use and, where appropriate, dedicated lifts should also be identified for use.
- 10.8 Input from Infection Control Specialists is essential in the planning of the building project as well as during, and on completion of, the construction work. HAI-SCRIBE should be applied as appropriate.

Issues to be considered include:

- refurbishment/new build project;
- workflow;
- infection risk/patient movement;
- specialised areas like theatres, critical care, laundry, treatment areas.

10.9 The prevention and control of infection measures to be considered will apply equally to new build and refurbishment projects.

10.10 Correct workflow systems must be maintained throughout the building project. Input from Infection Control Specialists is essential at each stage of the project, requiring close collaboration between Infection Control Specialists and the Design Team. This is especially important in the planning of specialised units like theatres and critical care facilities.

10.11 Most healthcare departments have clean-to-dirty workflow systems. Workflow is a fundamental of good prevention and control of infection practice and this needs to be reflected when the built environment is being considered. There is often an issue of space being at a premium and there is therefore the temptation to try to fit everything in. It is important to resist this temptation as problems caused by this may last the lifetime of the facility. The healthcare facility should be large enough to adequately accommodate activities taking place within it.

10.12 HAI-SCRIBE highlights the range of construction activities commonly undertaken in healthcare facilities and assesses the degree of risk in relation to population groups.

10.13 In order to ensure the risk of infection is minimised during construction works, consideration must be given to:

- the patient population group being treated;
- the type of construction work being carried out;
- the risk associated with these two factors.

Risk Management methodology

10.14 Kennedy (1996) developed a methodology which assesses the risk of infection from construction works and has highlighted the range of precautions needed to eliminate or manage this risk. Although this system was developed for use in the United States it can be applied to the redevelopment and refurbishment of healthcare facilities within NHSScotland.

<i>Risk to patients of infection from construction work in healthcare premises by clinical areas</i>		
Group 1	Lowest risk	<ol style="list-style-type: none"> Office areas. Unoccupied wards. Public areas.
Group 2	Medium risk	<ol style="list-style-type: none"> All other patient care areas (unless included in Group 3 or Group 4). Outpatient clinics (unless included in Group 3 or Group 4). Admission or discharge units.
Group 3	High risk	<ol style="list-style-type: none"> A & E (Accident and Emergency). Medical wards. Surgical wards (including Day Surgery) and Surgical outpatients. Obstetric wards and neonatal nurseries. Paediatrics. Acute and long stay care of the elderly. Patient investigation areas, including: <ul style="list-style-type: none"> Cardiac catheterisation; Invasive radiology; Nuclear medicine; Endoscopy. <p>Also (indirect risk)</p> <ol style="list-style-type: none"> Pharmacy preparation areas. Microbiology laboratories (risk of pseudo-outbreaks and unnecessary treatment).
Group 4	Highest Risk	<ol style="list-style-type: none"> Any area caring for immunocompromised patients*, including: <ul style="list-style-type: none"> transplant units and outpatient clinics for patients who have received bone marrow or solid organ transplants; oncology units and outpatient clinics for patients with cancer; burns units. All Intensive Care Units. All operating theatres. <p>Also (indirect risk)</p> <ol style="list-style-type: none"> CDUs (Central Decontamination Units).

***Immunocompromised patients** are those patients whose immune mechanisms are deficient because of immunologic disorders (e.g. human immunodeficiency virus [HIV] infection or congenital immune deficiency syndrome), chronic diseases (e.g. diabetes, cancer, emphysema, or cardiac failure), or immunosuppressive therapy (e.g. radiation, cytotoxic chemotherapy, anti-rejection medication, or steroids). Immunocompromised patients who are identified as high-risk patients have the greatest risk of infection caused by airborne or waterborne micro-organisms. Patients in this subset include persons who are severely neutropenic for prolonged periods of time (i.e. an absolute neutrophil count [ANC] of ≤ 500 cells/mL), allogeneic HSCT patients, and those who have received the most intensive chemotherapy (e.g. childhood acute myelogenous leukaemia patients). (CCDR 2001.)

Immunosuppressive conditions identified as risk factors for construction-related nosocomial fungal infections include graft-versus-host disease requiring treatment; prolonged neutropenia or granulocytopenia because of cytotoxic chemotherapy; prolonged use of antibiotics; and steroid therapy. Other risk factors for the development of aspergillosis include dialysis and mechanical ventilation, smoking and patient age, the very young and very old being at greater risk. Grauhan and colleagues reported that the risk of a fungal infection increases in patients who exhibit three or more risk factors ($p < 0.001$). (CCDR 2001.)

Table 7: Highlights the different population groups being treated in the healthcare facility and the degree of risk associated with them.

Type 1	Inspection and non-invasive activities. Includes, but is not limited to, removal of ceiling tiles for visual inspection, painting which does not include sanding, wall covering, electrical trim work, minor plumbing and activities which do not generate dust or require cutting of walls or access to ceilings other than for visual inspection.
Type 2	Small scale, short duration activities which create minimal dust. Includes, but is not limited to, installation of telephone and computer cabling, access to chase spaces, cutting of walls or ceiling where dust migration can be controlled.
Type 3	Any work which generates a moderate to high level of dust or requires demolition or removal of any fixed building components or assemblies. Includes but is not limited to, sanding of walls for painting or wall covering, removal of floor coverings, ceiling tiles and casework, new wall construction, minor duct work or electrical work above ceilings, major cabling activities, and any activity which cannot be completed within a single work shift.
Type 4	Major demolition and construction projects Includes, but is not limited to, activities which require consecutive work shifts, requires heavy demolition or removal of a complete cabling system, and new construction.

Table 8: Indicates the types of construction work being carried out within the healthcare facility

	Construction Project Type			
Patient Risk Group	TYPE 1	TYPE 2	TYPE 3	TYPE 4
Low Risk	Class I	Class II	Class II	Class III/IV
Medium Risk	Class I	Class II	Class III	Class IV
High Risk	Class I	Class II	Class III/IV	Class IV
Highest Risk	Class II	Class III/IV	Class III/IV	Class IV

Table 9: Estimates the overall risk of infection arising and will indicate the class of precaution that should be implemented.

Protection of sensitive areas

- 10.15 Having highlighted the overall degree of infection risk, appropriate control measures can be implemented to manage or eliminate the risk of transmission. Table 10 highlights the appropriate prevention and control of infection precautions.

	<i>During construction of a project</i>	<i>Upon completion of a Project</i>
Class I	<ol style="list-style-type: none"> 1. Execute work by methods to minimise raising dust from construction operations. 2. Immediately replace a ceiling tile displaced for visual inspection. 	<ol style="list-style-type: none"> 1. Clean areas.
Class II	<ol style="list-style-type: none"> 1. Provide active means to prevent airborne dust from dispersing into atmosphere. 2. Water mist work surfaces to control dust while cutting. 3. Seal unused doors with duct tape. 4. Block off and seal air vents. 5. Place dust mat at entrance and exit of work area. 6. Remove or isolate HVAC system in areas where work is being performed. 	<ol style="list-style-type: none"> 1. Wipe work surfaces with disinfectant. 2. Contain construction waste before transport in tightly covered containers. 3. Wet mop and/or vacuum with HEPA filtered vacuum before leaving work area. 4. Remove isolation of HVAC system in areas where work is being performed.
Class III	<ol style="list-style-type: none"> 1. Remove or Isolate HVAC system in area where work is being done to prevent contamination of duct system. 2. Complete all critical barriers ie plasterboard, plywood, plastic, to seal area from non work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. 3. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units. 4. Contain construction waste before transport in tightly covered containers. 5. Cover transport receptacles or carts. Tape covering unless solid lid. 	<ol style="list-style-type: none"> 1. Do not remove barriers from work area until completed project is inspected by the Board's Safety Department and Infection Control Department and thoroughly cleaned by the Board's Environmental Services Department. 2. Remove barrier materials carefully to minimise spreading of dirt and debris associated with construction. 3. Vacuum work area with HEPA filtered vacuums. 4. Wet mop area with disinfectant. 5. Remove isolation of HVAC system in areas where work is being performed.
Class IV	<ol style="list-style-type: none"> 1. Isolate HVAC system in area where work is being done to prevent contamination of duct system. 2. Complete all critical barriers ie plasterboard, plywood, plastic to seal area from non work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. 3. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units. 4. Seal holes, pipes, conduits, and punctures appropriately. 5. Construct anteroom and require all personnel to pass through this room so they can be vacuumed using a HEPA vacuum cleaner before leaving work site or they can wear cloth or paper coveralls that are removed each time they leave the work site. 6. All personnel entering work site are required to wear shoe covers. Shoe covers must be changed each time the worker exits the work area. 7. Do not remove barriers from work area until completed project is inspected. 	<ol style="list-style-type: none"> 1. Remove barrier material carefully to minimise spreading of dirt and debris associated with construction. 2. Contain construction waste before transport in tightly covered containers. 3. Cover transport receptacles or carts. Tape covering unless solid lid. 4. Vacuum work area with HEPA filtered vacuums. 5. Wet mop area with detergent to remove physical soiling before disinfecting area. 6. Remove isolation of HVAC system in areas where work is being performed.

Table 10: Describes the required Infection Control Precautions depending on class of risk (Adapted from Kennedy, 1997)

Ventilation of work site/pressurisation

- 10.16 Physical barriers erected to allow work activity should be robust and take account of the work activities and potential for damage that can breach this barrier. The work area, where practical, should be at a negative pressure with respect to the clean working areas. Avoid extract outlets discharging into the same areas as clean air intakes. Regular planned inspection of the site, visual airflow or pressure indicators and alarms should be considered.

Procurement

- 10.17 Infection Control Specialist input is essential at the procurement stage of any construction/refurbishment project. This input is initially required when consideration is being given to the selection of Architects and Designers. There is a case for stipulating that Architects and Designers for healthcare projects are suitably qualified in terms of their knowledge and understanding of prevention and control of infection.
- 10.18 The specification of building materials, especially surface finishes, healthcare facility equipment, etc should take account of input from the Infection Control Specialist.

Commissioning of systems and equipment

- 10.19 The work plan should allow for a phased approach to commissioning of systems. Once an area has been commissioned, it needs to be cleaned and sealed off. Equipment can then be cleaned and laid out providing access is strictly controlled prior to final handover.

Validation and verification of equipment

- 10.20 The Health and Safety files need to be complete and hold all necessary manuals and commissioning certificates. Any reusable medical device requires decontamination information and all necessary instructions. These should be obtained prior to purchase to ensure that the available decontamination facilities are able to deal with the device.

Planning for expansion

- 10.21 At the planning stage, the Planning and Design Team must ensure input from the Infection Control Specialist. This input would cover the proposed facility expansion and the measures to be put in place during the course of the construction project.
- 10.22 The prevention and control of infection input at the planning and design stage will mirror that for new build situations and reference should be made to Sections 8 and 9.
- 10.24 Reference should also be made to the appropriate question sets of HAI-SCRIBE.

Decant facilities

- 10.25 Major refurbishment or expansion projects would ideally benefit from the availability of a decant facility where patients could be transferred during the course of the construction work. Such a decant facility would also be very useful during the course of an infection outbreak to allow additional isolation/segregation capacity or in the case of an infection outbreak in the community additional patient capacity.
- 10.26 Given scarce resources and the need to apply health economics, the provision of decant facilities may be regarded as a desirable luxury. However, when consideration is given to the situations in healthcare facilities where a decant facility would be of real value in minimising the risk of infection spread, it may be appropriate to make some decant capacity available.

Environmental sampling/inspection

Physical monitoring

- 10.27 Physical monitoring of the healthcare environment including temperature, humidity, air change rates, leak rates, direction of air and water flow, particle counts and filter efficiency testing methods can help ensure that environmental conditions in the healthcare facility are such that they do not contribute to the spread of infection.
- 10.28 No single test can be relied upon to provide the whole picture and trends rather than individual readings are most useful. Areas such as theatres, positive and negative pressure rooms, sterile preparation areas in pharmaceutical facilities, sterile services etc. will have specific guidance for testing regimens. These are used mainly to determine that the area is fit for the desired purpose. In the event of any problem, these records are useful to determine investigation pathways.
- 10.29 Conditions likely to promote microbial contamination include high moisture levels in air, particularly when associated with high air temperature. Stagnant air, possibly through poor ventilation, can contribute to fungal contamination whilst excessive air turbulence can increase airborne particulate levels and contribute to the dispersal of micro-organisms.
- 10.30 The maintenance of the environment is important to ensure that areas are intact, functioning properly and in a state such that they can be cleaned properly.
- 10.31 Water testing in a variety of situations (e.g. endoscope washer-disinfectors and steam for autoclaves) may require chemical and endotoxin testing as well as tests for conductivity and hardness.
- 10.32 Visual inspection must be part of physical monitoring to ensure for instance that filters are fitted correctly, that surfaces are smooth, impervious, free of cracks and joins, and without the accumulation of dust which may harbour fungi and bacteria.

Microbial monitoring

- 10.33 In terms of quality assurance, microbial sampling of the air, water and surfaces of the healthcare facility has an important role to play in helping combat the spread of infection within the built healthcare environment. NHS Healthcare Bodies should have a formal protocol for the monitoring of the built healthcare environment with regard to the control of infection. When sampling of the area is carried out, the laboratory should have appropriate accreditation for carrying out the sampling. Some sampling may have to be performed in response to an investigation of an outbreak of infection. Results obtained should be interpreted using scientifically established baseline values for comparison e.g. Health and Safety Executive guidelines. On completion of analysis, actions to be implemented should be based on the results obtained.
- 10.34 The microbial monitoring protocols should be developed by the Infection Control Team, with input from other disciplines and bodies as appropriate. Areas where the built environment is suspected of contributing to the spread of infection or where construction or refurbishment work is proposed, should be referred to the Infection Control Team for consideration of monitoring and advice as appropriate.
- 10.35 Helpful advice is available from the United States in the CDC publication 'Guidelines for Environmental Infection Control in Health-Care facilities'. This document states that biological monitoring of the healthcare facility should occur in the following four situations (CDC 2003):
- to support the investigation of disease or infection where environmental reservoirs or fomites have been implicated epidemiologically in the transmission of the disease or infection;
 - for research purposes to provide information on the spread of infection within the built healthcare environment;
 - to monitor a potentially hazardous situation;
 - for quality assurance purposes as part of a quality control programme or to evaluate a change in prevention and control of infection.
- 10.36 Microbiological and other methods of sampling have an important role to play in training and education of healthcare staff.

Methods of microbial sampling

- 10.37 There are several types of microbial sampling methods. Conventional culture methods of microbial diagnosis are generally restricted by the amount of time it takes for qualification or quantification to occur. Culture techniques take a minimum of 18 hours to carry out and in some instances can take as long as 6 weeks.
- 10.38 There are a variety of methods and media available but many are poorly assessed and validated. In many circumstances there are no standards or set protocols for testing. Contact plates, swabs, enrichment versus selective media

and sensitivity of the method needs to be assessed in order to allow interpretation. It is important to know why the sampling is being carried out and the procedures to be implemented if abnormal results are found. Environmental sampling can place a heavy burden on clinical laboratories which may not be set up, funded or accredited for non-clinical sampling.

10.39 Non-culture techniques do not require pathogen multiplication and can be a more rapid method of detection. These methods are being utilised with increasing frequency, including techniques such as:

- antigen detection techniques e.g. Elisa;
- toxin detection techniques e.g. endotoxin assay;
- ATP(Adenosine Tri-phosphate) detection techniques e.g. bioluminescence, used in the food industry as a rapid hygiene test for surfaces;
- residue protein detection tests (ninhydrin tests);
- soil tests;
- cleaning efficacy tests;
- molecular techniques.

External specialist advice in the use of these and other rapid techniques is likely to be necessary.

10.40 Special consideration should be given to specialised areas such as control of Legionella. There is often specific guidance on such areas such as:

- Scottish Health Technical Memorandum (SHTM) 2040: 'The control of Legionellae in healthcare premises - a code of practice';
- Health and Safety Executive (HSE) Guidance Note L8 'Legionnaires Disease: The control of legionella bacteria in water systems. Approved code of practice and guidance'.

11. Operation/on-going maintenance

Importance of maintenance

- 11.1 Good design and equipment selection will ensure future maintenance is easy and cost effective. A planned maintenance system should be set up to start at the same time as handover or occupancy. A record of Planned Preventative Maintenance needs to be kept. Regular reviews of the building fabric should be undertaken as accidental damage to smooth surfaces makes effective decontamination difficult to achieve. The use of soft, difficult to decontaminate fabrics must be, as far as possible, avoided.

Access for maintenance

- 11.2 Where practical, maintainable elements should be located in separate plant rooms with easy access to plant and final connection through walls into clinical areas. Plant and services should be located behind panels that should be easily accessed with quick release fixings. Care should be taken when running services on the surface to avoid ledges where dust can collect. Equipment should be serviced *in-situ* where this helps to avoid cross infection. If equipment has to be removed from the area, consideration should be given to decontamination before and after servicing has been carried out.

Catering/food hygiene

- 11.3 All healthcare establishments must comply with requirements in the Food Safety Act 1990 (Scotland) and food hygiene regulations made under this Act. Reference should also be made to the Cook Chill Guidelines (DoH, 1989) and any other relevant legislation.

Ancillary areas

- 11.4 It is important that ancillary areas are of an appropriate standard and do not put the user at risk of cross-infection.
- 11.5 The evidence used is based on guidance from NHS Estates, England. Prevention and control of infection issues will depend on:
- the use of the ancillary area;
 - who will have access; and
 - the type of activity to be carried out there.
- 11.6 Ancillary areas include:
- dirty utility/sluisse;
 - clean utility/sterile products;
 - treatment room;

- disposal room;
- day room/patient waiting area;
- play area;
- nappy-changing area;
- visitors toilets.

Dirty utility room

- 11.7 A dirty utility room should include facilities for:
- the cleaning of dressing trolleys and other items of equipment;
 - testing urine;
 - disposal of liquid waste; and
 - temporarily holding items requiring reprocessing or disposal.
- 11.8 Space and facilities for holding and reprocessing of bed-pans, urinals and vomit bowls are required where in-patients are looked after (further guidance can be found in SHTM 2030: 'Washer Disinfectors'). Central Decontamination Units (CDUs) returns can also be held here, along with storage of sani-chairs, commodes and linen bag carriers.
- 11.9 Hand-hygiene facilities are necessary plus the provision of a 'slop-hopper' for disposal of body-fluid waste (SHPN 04: 'In-patient accommodation - options for choice') and a separate deep sink for decontaminating nursing equipment.

Clean utility room

- 11.10 A clean utility room is required where drugs and lotions may be stored and prepared. A working supply of clean and sterile supplies may be held and dressing trolleys prepared. Clinical hand-hygiene facilities are required.
- 11.11 In primary care facilities, the room should be located adjacent to the treatment area. It is important that planners think about the type of storage facilities provided; there must be sufficient storage area for sterile supplies equipment and other clean supplies to keep supplies off the floor. They must be able to be cleaned easily and quickly while protecting clean stores and equipment from dust and contamination.
- 11.12 Sterile and clean supplies should be stored away from any source of water splashing. Suitable storage will ensure packaging is not damaged while accessing supplies.

Treatment room

- 11.13 A treatment room may be required for in-patient examination or investigations on the ward. It will certainly be needed in primary care settings and will require different design features according to its planned use. For example, in areas

where immunisation, redressing or surgical intervention and investigations take place the following points should be considered:

- adequate numbers of hand-wash basins should be provided;
- space should be available to allow for the storage of equipment and sterile supplies;
- carpets should be avoided.

Disposal room

- 11.14 The disposal room is the temporary storage point for all items of supplies and equipment which have to be removed for cleaning, reprocessing or disposal, e.g. linen, reusable medical devices.

Day room/patient waiting area

- 11.15 There is often conflict between the aesthetics of these areas and the prevention of contamination of the environment or furnishings. This is especially the case in waiting areas such as in Accident and Emergency departments, primary care and minor injury units (SHPN 04: 'In-patient accommodation - options for choice').
- 11.16 It is important that where blood and body-fluid spillages may occur, the environment should be able to be cleaned so that micro-organisms do not survive and should be able to withstand the use of high concentrations of aggressive disinfectants.
- 11.17 Flooring should be cleanable and be able to withstand the use of detergents and disinfectants. Carpets are not recommended where spillage is anticipated.

Play area

- 11.18 There are prevention and control of infection implications for toy cleaning (i.e. how they should be effectively cleaned) and storage (i.e. the provision of adequate toy storage facilities) plus issues for cleaning equipment and multiple use areas such as soft play areas and play mats.
- 11.19 Porous or fabric toys should be avoided, as they cannot easily be decontaminated on site.

Nappy-changing area

- 11.20 Provision of a nappy-changing area is a necessary addition to any healthcare premises.
- 11.21 Facilities for disposal of soiled nappies and for hand-hygiene are required along with a regular cleaning programme for equipment used.
- 11.22 The area for nappy-changing should have a surface which can be easily cleaned.

Visitors' toilets

- 11.23 These are heavily used and should provide sufficient space and be of a high grade of finish to maintain a good standard of hygiene.
- 11.24 There should be provision of disposal facilities for sanitary waste in both women's and mixed-sex toilets.
- 11.25 The number of toilets and hand-wash basins provided must be sufficient for the anticipated population.

Recommendations

- 11.26 Ancillary areas provided as part of a ward, department, primary care facility or community home must be easily accessible, fit for the purpose and safe, both from a health and safety perspective and a prevention and control of infection perspective.
- 11.27 The prevention and control of infection issues in an ancillary area must be included along with other design features and will depend on what the ancillary area is to be used for, who will have access, and what type of activity will be carried out there.
- 11.28 Ancillary areas must be easily cleaned, have facilities for hand-hygiene, disposal of fluid and clinical waste, if appropriate, and sufficient storage for supplies and equipment.
- 11.29 Clean and dirty areas must be kept separate and the workflow pattern and management of each area must be clearly defined.

Cleaning frequency/quality

- 11.30 The ability to effectively maintain a clean environment is essential in the planning and design stage of any new facility. This applies to the general fabric of the building, along with the equipment selected.
- 11.31 Cleaning of all fixtures, fittings and equipment should be managed by way of planned cleaning schedules, based on routine cleaning frequencies. This will not only ensure a clean environment but will also extend the working life of the facility.
- 11.32 In addition to the cleaning frequency schedules, attention must be given to ensuring that appropriate staff training is carried out.
- 11.33 In order to maintain a facility in good condition, the design must allow for protection to walls which can regularly be subject to repeated damage from trolley traffic. Plans should also be made at an early stage to have the area included on the routine maintenance programme in order to maintain a high standard and minimise deterioration of the fabric. (Further guidance can be found in the NHSScotland National Cleaning Specification produced by the HAI Task Force.)

Ventilation

- 11.34 Ventilation should dilute airborne contamination by removing contaminated air from the room or immediate patient vicinity and replacing it with clean air from the outside or from low-risk areas within the healthcare building.
- 11.35 The ventilation must be sufficient to maintain a comfortable environment for staff and prevent the premises and equipment from overheating. Artificial ventilation systems must be constructed to permit access for cleaning and maintenance. Conditions which give rise to condensation should be avoided as condensation will encourage the growth of mould.
- 11.36 Care should be taken when servicing ventilation systems as air-flows and pressure changes can allow contamination of clinical areas. Dust or contamination in the ductwork or within the plant rooms can find their way into the system. Fire dampers should be of the self-resetting type to avoid accidental disruption of airflow. Filters need to be changed at regular intervals and care needs to be taken to avoid contamination of the system due to overloaded filters collapsing. Regular checks of the ductwork and diffusers should form part of the maintenance plan. Microbiological monitoring and commissioning of specialised ventilation should be in accordance with guidance in SHTM 2025: 'Ventilation in healthcare premises'. Ventilation systems should be designed to allow removal of filters without contaminating filtered air space.

Ventilation in the clinical setting

- 11.37 Research has suggested that in specialised areas, ventilation can reduce the incidence of healthcare associated infection such as wound infections and communicable diseases (Ayliffe et al, 2000; Sanchez and Hernandez, 1999; Fox, 1997; O'Connell and Humphreys, 2000; Holton and Ridgway, 1993; Humphreys, 1993).
- 11.38 Effective ventilation in healthcare premises involves the dilution of the airborne contamination by removing contaminated air from the room or immediate patient vicinity and replacing it with clean air from the outside or from low risk areas within the healthcare building. The use of specialised ventilation systems mainly relates to high risk units such as operating theatres, special care baby units, burns units, high dependency and intensive care units and areas such as isolation rooms (negative pressure ventilation for infectious patients and positive pressure ventilation for immuno-compromised patients).
- 11.39 Health Facilities Scotland SHPNs and SHTMs along with Codes of Practice for design of buildings give advice on 'natural' ventilation, general extract ventilation and ventilation for specialised areas such as operating theatres, hydrotherapy suites, isolation rooms and are referenced under the respective specialised areas.
- 11.40 Wound infection has traditionally been a major cause of morbidity resulting from surgical procedures. Improvements such as ultra-clean theatre ventilation have contributed to reduced morbidity and mortality in specialised areas such as orthopaedics (Lidwell et al, 1982).

- 11.41 Airborne infections have been associated within treatment areas where patients are immuno-compromised, for example haematology wards, bone marrow transplant units (Alberti et al, 2001; Sherertz et al, 1987).

Cost implications

- 11.42 In some clinical areas, the decision to install sophisticated ventilation systems which need routine or constant monitoring must be balanced against the risks and costs of such controls. The evidence on which to base the risk analysis is usually either absent or controversial. Where air movement is induced by mechanical ventilation, the flow of air must be from clean-to-dirty areas (where these can be defined). Hoffman et al (1999) state that *“investment in mechanical air systems is large and as with many other areas of infection control, it is difficult to measure their true effectiveness when such a measure would be the absence of sporadic events implicating a failure of the system”*.

Control and containment of infection

- 11.43 Ventilation of healthcare premises is considered in SHTM 2025: ‘Ventilation in healthcare premises’ which includes discussion of airflow and filtration:
- Humphreys (1993) states that whenever airborne infection is possible in theatres, the airflow must go from clean to contaminated areas, and not the opposite way;
 - Isolation rooms can be equipped with appropriate ventilation, i.e. negative or positive air pressure (but preferably not both);
 - information on planned maintenance of ventilation systems should be available ((see Health Facilities Scotland (formerly NHSScotland Property and Environment Forum) SHTM 2025: ‘Vol. 4 – Operational management’));
 - ultra-clean ventilation systems in operating theatres can reduce airborne contamination and subsequent wound infections more effectively in specialised areas such as orthopaedics;
 - Wagenvoort et al (1993) demonstrated the problems associated with intermittent interruption of electricity to ventilation systems which shuts the system down briefly.

Clean air and ventilation systems

- 11.44 Controlling airborne infection in relation to prevention of cross-infection in healthcare buildings remains a controversial subject. Hoffman et al (1999) divided the acute ward environment into:
- the ‘true environment’, which comprises those organisms normally found in any non-hospital environment, for example fungal spores; and
 - the ‘special hospital environment’ which consists mainly of organisms arising from patients, staff and visitors, for example tuberculosis.
- 11.45 The relative incidence of airborne infection in hospitals has been estimated to be about 10% (Schaal, 1991). However, this does not take into account such

factors as local respiratory pathogens, susceptibility of patients, climatic conditions, construction work, ventilation equipment and organisational policies in individual hospitals or wards.

- 11.46 The Control of Substances Hazardous to Health Regulations (COSHH) (1999) state that:

“Exposure to a biological agent shall be adequately controlled by designing work processes and engineering control measures so as to prevent or minimise the release of biological agents into the workplace.”

- 11.47 The COSHH Regulations require work processes to be safe by design. However, in some cases such as multi-drug-resistant tuberculosis (MDRTB), both ventilation and Personal Protective Equipment (PPE) will be required.
- 11.48 Shutters, access doors or air direction slats, if fitted, should be easily accessible for cleaning or removal.

Heating

- 11.49 A heating element is likely to be an integral part of the ventilation system and should be easily controlled and maintained. Natural convection currents caused by heat loss needs to be considered when calculating airflows and direction of airflow.

Heating/temperature control

- 11.50 Special consideration should be given to the type of heating, cooling and general ventilation systems provided in patient care and clinical areas. The heating and ventilation strategy should be appropriate for the setting.

Heat emitters (radiators)

- 11.51 Health Facilities Scotland (formerly NHSScotland Property and Environment Forum) Scottish Health Guidance Note: “Safe” hot water and surface temperatures’ provides guidance on how to prevent patients burning themselves on heat emitters.
- 11.52 The SHGN recommends options to ensure safety as follows:
- guards/covers should be fitted;
 - low surface temperature heat emitters should be used;
 - temperature controls should fail to a safe position.
- 11.53 Of these options, covered heat emitters have raised the most prevention and control of infection concern. Heat emitter covers allow dust to build up beneath and inside the heat emitter grille. This dust has been found to contain MRSA (meticillin resistant *staphylococcus aureus*) and other potentially pathogenic organisms, and when heat emitters are switched on during the winter months, dust and bacteria are dispersed by heat convection to the ward area.

- 11.54 Where heat emitter covers are used, regular planned maintenance and cleaning should be undertaken to prevent the problems described.
- 11.55 When installing heat emitters, it is recommended that there be adequate space underneath the heat emitter to allow cleaning machinery to be used. These areas may suffer from a lack of planned maintenance and cleaning and, as such, can become heavily contaminated with dust and potentially pathogenic organisms.

Pipework siting and access

- 11.56 'Hidden' heating may provide a solution to the problems of cleaning as long as access is possible for regular planned maintenance and cleaning. Pipework running along a wall can easily trap dust. Pipework mounted on walls should be encased to facilitate easy cleaning.

Heating and ventilation grilles and diffusers

- 11.57 General heating/ventilation grilles and diffusers need to be accessed easily for inclusion in cleaning programmes by domestic staff. When infection outbreaks occur, it is essential that these fixtures and fittings are included in the remedial cleaning process. Therefore, the ability for them to be easily removed and cleaned away from the patient area is essential in limiting cross contamination. Cotterill et al (1996) and Kumari et al (1998) describe outbreaks associated with general ventilation grilles in an intensive care unit and an orthopaedic ward.

Supply and extract ductwork

- 11.58 Supply and extract ductwork should be installed in such a way that it can be accessed at pre-defined regular intervals and cleaned along their full length including all components.

Ceiling or wall mounted air-conditioning units

- 11.59 These can be extremely difficult to clean due to the fact their interstices can get very dusty. Any decision to install them should be taken with great caution and the need to close the ward/department to enable satisfactory cleaning to be undertaken also needs to be considered. Their use in high-risk areas should be undertaken with caution.

Water systems

Wash facilities

- 11.60 Due to the difficulty of cleaning of baths after each patient, showers are generally more acceptable to both patients and infection control personnel. However, showers have been implicated in outbreaks of infection due to *Legionella* spp. (Tobin et al, 1980). Such problems, however, can be minimised by proper planned maintenance.

- 11.61 WCs, bathrooms and showers should be designed and installed to aid cleanliness and prevent cross-contamination. Toilet facilities must have facilities for hand-hygiene and SHPN 4: 'In-patient accommodation - options for choice' recommends that they should be no more than 12 metres from the bed area or dayroom.
- 11.62 Claesson and Claesson (1995) documented an outbreak of endometritis in a maternity unit caused by spread of *S. pyogenes* (sometimes referred to as Group A *streptococci*) from a showerhead and their conclusion was that showers, when used to clean the perineum following childbirth, pose a definite risk for post-partum endometritis. Again, proper planned maintenance should minimise this risk.

Protection of immuno-compromised patients

- 11.63 For areas with patients who have lowered immune responses, water fittings (washers, etc) should not support microbiological growth. Guidance can be sought from the Water Regulations Advisory Scheme (WRAS) (2001) 'Water Fittings and Materials Directory' and from BS 6920-1:2000 'Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water'.
- 11.64 Patients who have a lowered immune response are at risk from certain organisms found in water supplies in hospital, and as such, will need to be protected from this problem both in drinking water and wash-water facilities. Steinert et al (1998) and Miyamoto et al (2000) discuss the effects of plumbing systems on *Legionella* spp. in hospital hot-water systems and methods of disinfecting.
- 11.65 Graman et al (1997) demonstrated how an outbreak of healthcare associated legionellosis was traced to a contaminated ice machine. Manangan et al (1998) produced guidance on the sanitary care and maintenance of ice-storage chests and ice-making machines in response to the problems and requests for guidance from infection control professionals. Guidelines were also produced by Burnett et al (1994).
- 11.66 In another incident with an ice-making machine, an MDA Hazard Notice (Hazard (93) 42), was circulated following a report that leukaemia patients receiving chemotherapy treatment had developed septicaemia as a result of infection with *Stenotrophomonas maltophilia*. The source of this infection was traced to the storage cabinet of the ice-making machine in the ward. The Notice gave guidance for immediate action to ensure that ice is made directly from water that is of drinking quality.
- 11.67 Ice for the immuno-compromised should be made by putting drinking water into single-use icemakers, then into a conventional freezer.
- 11.68 Bosshammer et al (1995) carried out comparative hygienic surveillance of contamination with *Pseudomonas* spp. in a cystic fibrosis ward over a four year period and demonstrated how segregation of colonised and non-colonised

patients was undermined through transfer of strains from a highly contaminated environment, that is, taps, sinks and wash basins.

- 11.69 Sniadack et al (1993) demonstrated how a pseudo-outbreak of *Mycobacterium xenopi* was attributable to exposure of clinical specimens to tap-water. This included rinsing of bronchoscopes with tap-water after disinfection; irrigation with tap-water during colonoscopy; gargling with tap-water before sputum specimen collection and collecting urine in recently rinsed bed-pans.
- 11.70 Showers have been implicated in outbreaks of legionellosis in a transplant unit (Tobin et al, 1980) and on an alcoholism rehabilitation ward (Burns et al, 1991).
- 11.71 Water has been implicated in outbreaks not only from drinking water sources but also when it has been used for processing specimens in equipment such as dialysis machines.

Wastewater

Wastewater and sanitation

- 11.72 Domestic sewage contains a large number of intestinal organisms and is therefore hazardous. It must therefore be disposed of via a safe system internally to the external wastewater sewerage systems for treatment.
- 11.73 This waste will include water and body fluids from sanitaryware such as toilets and bidets plus drainage systems from mortuary tables and waste disposal systems and washer-disinfectors.
- 11.74 Wastewater is generated from a huge number of tasks carried out in healthcare buildings, which range from domestic cleaning, hand-hygiene, specialised laundries, surgical operations and areas such as renal dialysis units. Most of the wastewater contains micro-organisms from blood and body fluids and therefore has the potential for cross-infection if not disposed of safely.

Sanitary facilities

- 11.75 These not only include WCs and bidets but also equipment to assist patients who are unable to use a WC such as commodes and bed-pans, plus the equipment to disinfect this equipment such as bed-pan washer-disinfectors and macerators. The importance of cleaning in and around sanitary areas has also been shown in investigations of outbreaks caused by *Clostridium difficile* (Zafar et al, 1998; Cartmill et al, 1994. (Further guidance on cleaning can be found in NHSScotland National Cleaning Specification produced by the HAI Task Force.)
- 11.76 Healthcare facilities have recently seen increasing numbers of patients with *C. difficile*, vancomycin-resistant enterococcus (VRE) and diarrhoea and vomiting due to small round structured virus (SRSV). The degree of environmental contamination appears to be a determining factor in healthcare associated infection with sanitary facilities acting as 'hot spots' for transmission.

Internal drainage system

- 11.77 An internal drainage system must use the minimum amount of pipework, retain water and be airtight at joints and connectors. It must be sufficiently ventilated to retain the integrity of water seals.
- 11.78 The design should comply with the relevant British Standards and Codes of Practice, including BS EN 12056 and the current Building Regulations. Recommendations for spatial and access requirements for public health engineering services are contained in CIBSE (Chartered Institution of Building Services Engineers) Guide G, 1999 and SHTM 2023: 'Access and accommodation for engineering services'.
- 11.79 Provision for inspection, rodding and maintenance should be located to minimise disruption or possible contamination and manholes should not be sited within the building.

Waste disposal sinks

- 11.80 Sufficient and suitably located waste disposal sinks, for example slop-hoppers, should be provided to prevent contamination of hand-wash basins by disposal of wastewater.

Bed-pan washer-disinfectors/macerators

- 11.81 Where reusable bed-pans are used, ward areas require adequate and suitable bed-pan washer disinfectors that comply with SHTM 2030: 'Washer-disinfectors'. Wards housing certain specialised areas, for example urology wards, will need more than one bed-pan washer-disinfector. It should be noted that new BS and EN guidance will be issued on bed-pan washer-disinfectors.
- 11.82 Individual assessment of need should be made, as a uniform policy may lead to some areas being under-resourced. This also applies to the provision of macerators where disposable systems are used. Where macerators are used, there should be facilities to wash-disinfect bed-pan holders.
- 11.83 Rutala and Weber (1999) detail the role of disinfection and sterilization and discuss sanitary equipment in what they term 'non-critical item decontamination'. With the emergence of Vancomycin Resistant Enterococcus (VRE) as a healthcare associated pathogen during the past five years, urine containers and bed-pans have been implicated in outbreaks (Bonten et al, 1996).
- 11.84 Control or containment of these outbreaks depends on many factors, but not least the safe disposal of wastewater and sanitation and cleanliness of the equipment/environment.
- 11.85 Where fitted, bed-pan washer-disinfectors should be installed according to the Water Supply (Water Fittings) Regulations 1999 to prevent backflow and contamination.

Lighting

- 11.86 Lighting should be planned so that lamps can be easily cleaned with no edges or ridges where dust can gather. Lighting including emergency lighting should be maintained in good working order and maintenance records kept. Care needs to be taken when removing the diffusers as this is likely to disturb dust and may lead to contamination of the clinical area. Regular cleaning of these fittings in clinical areas should form a part of the Maintenance Plan.
- 11.87 Lighting levels should be maintained according to the recommendations for specific areas such as wards (day and night), theatres, corridors, examination rooms, ancillary or utility rooms and specific areas such as critical care units so that observation of patients is achieved without glare (SHTM 2007: 'Electrical services, supply and distribution'). Additional task lighting needs to be provided in certain areas.
- 11.88 Location and design of luminaires should afford easy changing of lamps and frequent cleaning. They should be designed so that there are no ledges, ridges, etc. where dust can gather easily, build up and then be dispersed if the light is knocked or moved.
- 11.89 Light quality is as important as quantity and may help avoid mistakes such as invasive injuries during operative procedures or examinations.
- 11.90 Efficient lighting in all areas of wards or departments enables domestic staff to undertake cleaning more effectively.

Transportation

Movement/transfer of an infectious patient

- 11.91 Additional precautions should be observed and maintained when transferring a patient with an infection throughout the healthcare facility and during ambulance transport. It is important to limit movement and transportation of the patient only to that required for essential purposes.
- 11.92 If a patient is to be transferred it is essential to inform the receiving area of required precautions prior to patient transportation. Traffic in isolation/segregation areas should also be minimised.

Environmental control

- 11.93 Control of the physical environment includes monitoring parameters such as temperature, humidity and air change rates. Where practical, the environmental controls should be linked to a building management system capable of continual monitoring. Where this is not practical then regular testing of the system, appropriate to the application, will be required with appropriate records being kept.

Electrical supply and distribution

- 11.94 Guidance on supply and distribution can be found in SHTM 2007: 'Electrical services, supply and distribution'. Guidance on installation and testing is laid down in the current I.E.E. Regulations and should be followed with appropriate records being kept. Responsibility for ensuring commissioning and testing is carried out correctly lies with the building owner/occupier.

Bedhead services/patient entertainment

- 11.95 Bedside patient entertainment and communications systems may be provided by private companies.
- 11.96 The bedside entertainment units are located in the wards at each bed. Cleaning of these units must comply with prevention and control of infection requirements and be approved by Infection Control personnel.
- 11.97 To this end, bedside entertainment units should be specifically designed with the healthcare facility environment in mind. All surfaces should be smooth, allowing effective cleaning with no areas that allow dirt to be trapped.
- 11.98 The system should allow each bedside entertainment unit cleaned to be logged, so that a detailed account of frequency and adherence to the cleaning specification is maintained.
- 11.99 A cleaning specification must be in place to ensure compliance with the Prevention and Control of Infection Procedures for cleaning areas and equipment in isolation rooms or bed areas where patients have a known infection. (Further guidance can be found in the NHSScotland National Cleaning Specification produced by the HAI Task Force.)

Medical gases: access and accommodation for services

- 11.100 Vacuum and suction equipment is a potential cross-infection risk. The delivery system is similar to that of gases, i.e. piped or via mobile equipment. The vacuum pipe system must be able to be isolated in case of incidents where pipework becomes contaminated with blood/body fluid. Contamination of piped vacuum systems can cause problems for Estates personnel. Access to the pipework may involve removal of the wall and ceiling fabric. The use of vacuum controlled units with overflow protection devices is essential to avoid contaminating the system with aspirated body fluid.
- 11.101 Guidance on the routine maintenance of Medical Gas equipment is laid down in SHTM 2022: 'Medical Gas Pipeline Systems'. SHTM 2022 gives guidance regarding piped medical gases and vacuum systems, and includes recommendations on:
- emergency procedures;
 - power failure;
 - access for cleaning contaminated vacuum systems;

- training and communication;
- maintenance and infection risk.

11.102 In some instances, surface mounted containment of pipework is unavoidable. If this is the case, regular cleaning of high-level ledges should be undertaken. Should any carry-over of body fluids occur within the piped vacuum system, advice should be sought from infection control. Again record keeping is critical for these services. Before carrying out any maintenance work on vacuum systems and/or changing bacterial filters, the Infection Control Team should be informed so that advice can be given on any appropriate precautions to be observed.

Lifts

11.103 Routine maintenance of lifts is covered by SHTM 2024: 'Lifts'. Regular cleaning of the car should be undertaken, however, care should be taken during this procedure to isolate the automatic call function. Record keeping is critical for this service.

Laundry facilities

- 11.104 There should be separate storage areas for both clean linen and the storage of linen awaiting collection or laundering (see SHPN 04: 'In-patient accommodation - options for choice').
- 11.105 Due to the working environment for staff, professional advice needs to be taken from a number of authorities namely, Infection Control, Estates, Health and Safety, Fire Safety and Occupational Health.
- 11.106 Laundry requires to be thermally disinfected during the laundering process. Laundry from hospitals and healthcare facilities may be contaminated with blood or body fluids and may have been used on infected patients.
- 11.107 Segregation of linen is of the utmost importance to prevent cross contamination when it comes to dealing with laundry. Clean and dirty areas must be well controlled.
- 11.108 Linen requires segregation into four categories:
1. Used linen.
 2. Soiled linen.
 3. Infected linen, which should be placed in a water-soluble liner or bag before being placed into a laundry bag.
 4. Heat labile linen.
- 11.109 Procedures must be in place to ensure all staff are trained in segregation within the ward/department and the laundry to ensure that there are safe work practices for handling of laundry.

- 11.110 When designing a healthcare laundry there should be clear workflow patterns in order that there is no cross over from clean to dirty areas. Dirty linen should come in and be able to be stored, short term, and then taken to be washed with the process continuing to the end of production, where a clean storage area will be available. It must be easy to identify which area of the laundry staff work in e.g. colour-coded uniforms.

Equipment

- 11.111 The correct choice of laundry equipment is important in order that thermal disinfection takes place during the laundering process i.e. that the correct temperatures are reached, and machinery must be maintained and calibrated regularly.

Cleaning

- 11.112 Space must be available around machinery, and safe access available to laundry and domestic staff, to allow the correct standards of cleaning to be maintained.
- 11.113 The laundry environment encourages dust and debris to develop and must be cleaned on a regular basis.

Ventilation

- 11.114 The ventilation strategy for a laundry facility should take into account the heat and dust generated in parts of the facility. Mechanical cooling should only be provided where other means of limiting temperature rise have been assessed and rejected on the basis of a full life-cycle cost analysis basis. The ventilation strategy must minimise the level of airborne contamination and dust and minimise the risk of cross infection.

Staff facilities

- 11.115 Hand hygiene facilities must be available throughout the laundry so that staff have access to this at all times during their working day. Adequate staff changing facilities with shower rooms should also be available in the event of spillage or contamination.

Waste handling

- 11.116 Waste is a major issue within the healthcare environment and there are many legislative controls and guidelines for the management of waste, to protect patients, visitors, staff and contractors working within this environment. (Further guidance can be found in SHTN 3: 'Management and disposal of clinical waste'.)
- 11.117 Good design of waste management processes can minimise problems with waste segregation, storage and disposal.

- 11.118 This part of the document discusses the problems of waste management and the guidance which must be adhered to if patients, staff and contractors are to be protected. The reality is that the disposal of waste is often poorly managed and inadequately catered for in wards, departments and community healthcare establishments and this can lead to escalating costs and heightened risks to healthcare staff.
- 11.119 Following a study of hospital waste management on 13 hospital sites, the Audit Commission (1997) stated that on average an acute hospital of 500 beds produces over 10 tonnes of waste per week. Some of the waste, such as paper, food scraps, flowers and bottles, is disposed of into the household waste stream and costs between £20 and £70 per tonne. The rest consists of clinical waste and special waste and costs considerably more to dispose of, typically between £300 and £500 per tonne.
- 11.120 Areas discussed include:
- identification/segregation;
 - disposal/clinical bins;
 - hospital waste;
 - community waste;
 - construction waste;
 - final disposal;
 - clinical implications.

Identification/segregation

- 11.121 Identification of categories and the means of segregation of clinical and special waste form the key elements of a waste disposal strategy. Waste is a risk not only to healthcare staff but also to their colleagues, patients, visitors and contractors. Increasing costs, litigation and damage to the environment are also areas for concern.
- 11.122 The means of segregation will depend on the ratio of clinical waste to non-clinical waste. Space at the ward/unit level is needed for suitable waste containers, whether the area served produces large or small amounts of clinical waste and household waste. Bins must be supplied in the appropriate areas according to amounts produced.
- 11.123 Current strategies for clinical waste management are outlined in SHTN 3: 'Management and disposal of clinical waste' along with the present legislative and regulatory framework and guidance. It should be noted that at the time of writing, waste legislation is changing rapidly.

Disposal/clinical bins

- 11.124 Clinical waste bin lids sustain the heaviest bacterial contamination and need to be capable of being suitably cleaned and disinfected, therefore, the use of bins with sack holders to allow for adequate cleaning is recommended.
- 11.125 Bins should be foot-operated only, and the foot pedal should be sturdy and durable.

Hospital waste

- 11.126 Storage in large 'Eurobins' in hospital streets (corridors) has been used for clinical waste. However, Eurobins are unsightly and should be removed where possible. Therefore, any new developments should allow for secure disposal storage cupboards sited at the entrance to the ward or department, preferably with access from both ward and hospital street. Waste can then be stored in this area instead of cluttering up dirty utility rooms, which are often inadequate for this purpose, while awaiting collection by the portering staff.
- 11.127 These rooms can be combined with those for soiled linen and household waste, but must be clearly subdivided so that the three types of waste are separated from each other. This will assist rapid collection and should minimise the risks of items for reprocessing being accidentally taken for disposal by incineration.
- 11.128 The subdivided areas must be able to be cleaned in the event of spillage and must be able to contain any spillage that does occur. The hold area should be large enough to hold a wheelie-bin or similar depending on the waste management strategy chosen, which in turn would reduce handling and the subsequent risks to porters. A designated, secure collection bay is also necessary to hold bins until waste is either incinerated/compacted/treated on-site or transported off-site for incineration.
- 11.129 Staff handling of waste sacks after removal from waste bins must be avoided and any decanting of waste into larger bins must be automated where possible to minimise manual handling risks.

Community waste

- 11.130 In healthcare facilities such as nursing/residential homes and primary care settings, all waste must be contained in bags inside a lockable container.
- 11.131 The system and frequency of collection of waste for the particular area needs to be taken into account when planning facilities for temporary holding bays, etc. If located externally, the holding bay or bin must be washable, secure and rodent-proof.
- 11.132 There must be a strict routine for removing waste to ensure it does not remain uncollected for extended periods. Further guidance is given in SHTN 3: 'Management and disposal of clinical waste'.

Construction waste

- 11.133 Each year in the UK, 70 million tonnes of waste are produced by the construction industry and for projects attached to existing healthcare facilities this can cause considerable risk to highly susceptible patients. It is important that this dust and debris are controlled and disposed of safely.
- 11.134 Barrier systems must be erected and closed waste containers supplied as necessary to avoid contamination of occupied areas.
- 11.135 Traffic control through designated entry and exit areas and dedicated lifts should be identified, if possible.
- 11.136 The management and minimisation of construction waste must be designed into the project.

Final disposal

- 11.137 Space at the ward/unit level is needed for provision of suitable secure waste containers, whether the area served produces large or small amounts of clinical waste. The storage facilities provided will vary with the type of healthcare facility and method of final disposal.
- 11.138 Final disposal is mainly achieved by the use of commercial, high temperature incinerators capable of meeting the increasingly tight emission limits set out by UK regulations.
- 11.139 Under the Environmental Protection Act 1990, certain types of clinical waste such as pharmaceuticals and chemicals must be incinerated at high temperature. However, much of what is usually designated as 'clinical waste' does not necessarily have to be burned but must be rendered safe.
- 11.140 Current strategies for clinical waste management are outlined in SHTN 3: 'Management and disposal of clinical waste' with the present legislative and regulatory framework and guidance. The Audit Scotland Baseline report (2001) entitled 'Waste Management in Scottish Hospitals' and the subsequent follow up report (2005) also contains an overview of waste management strategies.
- 11.141 In the past, in many cases, waste management has not been given the priority it requires and is still, in some cases, poorly handled and catered for within healthcare premises, both in the acute and the primary care setting. Thought must be given to adequate storage facilities for waste in a new build and when upgrading is taking place.
- 11.142 There are various categories of waste i.e. household waste going into the landfill waste stream, and such waste going for recycling or indeed confidential waste for destruction and clinical waste which must be rendered safe by heat treatment and where body parts and special waste are for disposal then this must be by incineration. (National contracts are in place meeting legislative compliance.) Thought must also be given to recycling particularly paper waste, which makes up a high percentage of our waste.

- 11.143 There must be appropriate space at ward level for suitable waste containers and multiple handling of waste should be avoided where possible. Dispose of waste as near to point of use as possible.
- 11.144 The correct number of bins should be in place for the amount and types of waste being produced and these bins should be foot operated and suitable to be cleaned and disinfected. Classification/guidance on types of waste and appropriate storage can be found in SHTN 3: 'Management and disposal of clinical waste'.
- 11.145 Storage areas for waste should be at the entrance to a ward or department with easy access for portering staff to pick up, not in dirty utility rooms, which in existing establishments do not provide enough space. Ideally these areas should be able to store wheelie bins, sharps boxes, magpie boxes for glass and aerosols, dirty linen in order that all waste is in one place, easily identifiable and easily collected by portering staff.
- 11.146 The storage area should be easily cleaned and spillages easily dealt with. For example, sheet vinyl on the floors and particularly covering the walls should be encouraged to avoid damage and contamination.
- 11.147 When waste leaves the storage area it should be taken to its final destination where it can be held in a designated storage bay before it is incinerated, compacted, treated on site or taken off site for incineration or heat treatment.
- 11.148 Within primary care and community settings, waste must be kept in a lockable container, bin store etc and the appropriate frequency of collection agreed at the time of planning the premises in order that the store is large enough to cope with the amount of waste generated.
- 11.149 As before, the area is required to be easily maintained and kept clean.

Access to decontamination facility

- 11.150 Access to the decontamination facility should be such that it does not contribute to the spread of infection. As such, there should be appropriate decontamination facilities provided centrally for decontamination of reusable medical devices and the system in operation should comply with the current guidance on decontamination facilities and procedures. Not all items reprocessed centrally will be sterilized, for some forms disinfection will be the end point.

Decontamination equipment

- 11.151 Decontamination is the combination of processes which include cleaning, disinfection and sterilisation used to render a reusable medical device safe for reuse on patients and for handling by staff. This part of the document discusses the importance of decontamination of reusable medical devices and the evidence which can be used as a useful checklist for planning areas in the built environment.

- 11.152 For maintenance and validation, follow the guidelines laid down by the Infection Control Manager and the relevant SHTMs; 2030, 2031 and 2010. Record keeping forms a critical part of the management of decontamination for these types of equipment.
- 11.153 The effective decontamination of medical devices is essential in reducing the risks to patients from healthcare associated infection and minimising the potential iatrogenic transmission of Transmissible Spongiform Encephalopathies (TSEs), that is, Creutzfeldt–Jakob Disease (CJD), variant Creutzfeldt–Jakob Disease (vCJD), Gerstmann–Sträussler–Scheinker Disease (GSS) etc.
- 11.154 At each stage in the decontamination process, consideration should be given to location, facilities, equipment, management and policies/procedures.
- 11.155 Areas discussed in this part of the document include:
- decontamination and healthcare associated infection;
 - transmission of TSEs including vCJD;
 - decontamination assessment tools;
 - decontamination facilities and accommodation.

Decontamination and healthcare associated infection

- 11.156 It has been demonstrated that 10% of in-patients acquire a hospital acquired infection (now referred to as healthcare associated infection) at any one time (Plowman et al 1999), the most common being urinary tract infection, surgical wound and lower respiratory tract infection.
- 11.157 There are common risk factors which cause infection, but it is not known how many infections could be prevented by improving decontamination procedures; however, it is known that failure in decontamination processes can result in a range of infections.
- 11.158 Saksena et al (1999) reported that transfer of infectious material had been demonstrated in inadequately decontaminated instruments. Scottish Healthcare Supplies Hazard Notice (SC) 95/02, referred to water contaminated with *Pseudomonas aeruginosa* being used to flush the lumens of a microsurgical hand-piece, which subsequently suffered ineffective sterilization before use. Three patients who had undergone surgery at the same time were found to be infected.
- 11.159 The possibility that TSEs might be spread from person to person in healthcare situations may arise for a number of reasons:
- classical CJD has been transmitted from person to person by medical procedures;
 - abnormal prion protein has been demonstrated in the lymphatic tissue (including tonsils) of patients with established vCJD;

- abnormal prion protein has been demonstrated in the appendix of a patient who subsequently developed vCJD;
- abnormal prion protein may not be inactivated by normal sterilization procedures.

11.160 Research which gave rise to these concerns includes the identification of the abnormal form of prion protein reported in the appendix removed from a patient some months before he went on to develop clinical signs of vCJD (Hilton et al, 1998). This was the first time that the presence of abnormal prion protein had been detected in peripheral tissues before the onset of clinical disease. Furthermore, in another study (Hill et al, 1999), lymphoreticular tissues (tonsils, spleen and lymph nodes) from patients with neuropathologically confirmed vCJD were found to be positive for the abnormal protein associated with prion diseases.

11.161 The Spongiform Encephalopathy Advisory Committee (SEAC), which advises the Government on BSE/CJD issues, has advised that rigorous implementation of washing, decontamination and general hygiene procedures are key measures in reducing the risk of vCJD transmission via surgery. A risk assessment model developed by the Department of Health (DH) at SEAC's request and updated in June 2005 confirms this: 'Assessing the risk of vCJD transmission via surgery: an interim review', available on the DH website at <http://www.dh.gov.uk/assetRoot/04/11/35/42/04113542.pdf>.

Decontamination facilities and accommodation

11.162 If decontamination is to be undertaken in a safe and effective manner which reduces risk and contributes to a reduction in healthcare associated infection, then it must be carried out in a suitable environment, with validated automated processes, managed and operated by trained staff.

11.163 Centralised reprocessing of surgical instruments is the preferred option and local reprocessing should be the exception rather than the norm. Accommodation provided for decontamination should be designed and operated in a manner that does not contribute to the overall bio-burden of the instruments being processed. SHPN 13: 'Sterile Services Department' provides advice and guidance on provision of central sterile supply accommodation. Where local provision is required then it must be carried out to the same standard as central reprocessing. Further information on Local Decontamination Units can be found on the Health Protection Scotland (HPS) website <http://www.show.scot.nhs.uk/scieh/infectious/hai/decontamination/haidecon.htm>.

11.164 When designing clinical accommodation, consideration should be given to providing adequate and appropriate storage for centrally provided sterile supplies. If sterile supplies are stored inappropriately, then sterility can be compromised and contamination can occur.

Drainage

- 11.165 Care needs to be taken to ensure access for dismantling and cleaning of drainage if required. The use of glass traps will allow for monitoring of critical areas as necessary. Where it is important to maintain hygiene conditions within drainage systems, or integrity of water seals, regular flushing programmes should be implemented.

Sanitation

- 11.166 Regular maintenance of all sanitaryware is essential. Glazed surfaces free from cracks are easier to maintain. Care should also be taken where surface mounted equipment forms ledges at high levels which need to be cleaned regularly.

Environmental sampling

Physical monitoring

- 11.167 Physical monitoring of the healthcare environment including temperature, humidity, air change rates, leak rates, direction of air and water flow, particle counts, filter efficient testing methods, can help ensure that environmental conditions in the healthcare facility are such that they do not contribute to the spread of infection.
- 11.168 No single test can be relied upon to provide the whole picture and trends rather than individual readings are most useful. Areas such as theatres, positive and negative pressure rooms, sterile preparation areas in pharmaceutical facilities, sterile services etc will have specific guidance for testing regimens. These are used mainly to determine that the area is fit for the desired purpose. In the event of any problem, these records are useful to determine investigation pathways.
- 11.169 Conditions likely to promote microbial contamination include high moisture levels in air, particularly when associated with high air temperature. Stagnant air, possibly through poor ventilation, can contribute to fungal contamination whilst excessive air turbulence can increase airborne particulate levels and contribute to the dispersal of micro-organisms.
- 11.170 The maintenance of the environment is important to ensure that areas are intact, functioning properly and in a state such that they can be cleaned properly.
- 11.171 Water testing in a variety of situations (e.g. endoscope washer-disinfectors and steam for autoclaves) may require chemical and endotoxin testing as well as tests for conductivity and hardness.
- 11.172 Visual inspection must be part of physical monitoring to ensure for instance that filters are fitted correctly, that surfaces are smooth, impervious free of cracks and joins, and there is no accumulation of dust which may harbour fungi and bacteria.

Microbial monitoring

- 11.173 In terms of quality assurance, microbial sampling of the air, water and surfaces of the healthcare facility has an important role to play in helping combat the spread of infection within the built healthcare environment. NHS Healthcare Bodies should have a formal protocol for the monitoring of the built healthcare environment with regard to the control of infection. Some sampling may have to be performed in response to an investigation of an outbreak of infection. Results obtained should be interpreted using scientifically established baseline values for comparison e.g. Health and Safety Executive guidelines. On completion of analysis, actions to be implemented should be based on the results obtained.
- 11.174 The microbial monitoring protocols should be developed by the Infection Control Team, with input from other disciplines and bodies as appropriate. Areas where the built environment is suspected of contributing to the spread of infection, or where construction or refurbishment work is proposed should be referred to the Infection Control Team for consideration of monitoring and advice as appropriate.
- 11.175 Helpful advice is available from the United States in the CDC publication 'Guidelines for Environmental Infection Control in Health-Care facilities'. This document states that biological monitoring of the healthcare facility should occur in the following four situations (CDC; 2003):
- to support the investigation of disease or infection where environmental reservoirs or fomites have been implicated epidemiologically in the transmission of the disease or infection;
 - for research purposes to provide information on the spread of infection within the built healthcare environment;
 - to monitor a potentially hazardous situation;
 - for quality assurance purposes as part of a quality control programme or to evaluate a change in prevention and control of infection.
- 11.176 Microbiological and other methods of sampling have an important role to play in training and education of healthcare staff.

Methods of microbial sampling

- 11.177 There are several types of microbial sampling methods. Conventional culture methods of microbial diagnosis are generally restricted by the amount of time it takes for qualification or quantification to occur. Culture techniques take a minimum of 18 hours to carry out and in some instances can take as long as 6 weeks.
- 11.178 There are a variety of methods and media available but many are poorly assessed and validated. In many circumstances there are no standards or set protocols for testing. Contact plates, swabs, enrichment versus selective media and sensitivity of the method needs to be assessed in order to allow

interpretation. It is important to know why the sampling is being carried out and what will need to happen if abnormal results are found. Environmental sampling can place a heavy burden on clinical laboratories which may not be set up, funded or accredited for non-clinical sampling.

11.179 Non-culture techniques do not require pathogen multiplication and can be a more rapid method of detection. These methods are being utilised with increasing frequency, including techniques such as:

- antigen detection techniques e.g. Elisa;
- toxin detection techniques e.g. endotoxin assay;
- ATP(Adenosine Tri-phosphate) detection techniques e.g. bioluminescence, used in the food industry as a rapid hygiene test for surfaces;
- residue protein detection tests (ninhydrin tests);
- soil tests;
- cleaning efficacy tests;
- molecular techniques.

11.180 Special consideration should be given to specialised areas such as control of Legionella. There is often specific guidance on such areas as the:

- Scottish Health Technical Memorandum (SHTM) 2040: 'The control of Legionellae in healthcare premises - a code of practice';
- Health and Safety Executive (HSE) guidance Note L8 'Legionnaires Disease: The control of legionella bacteria in water systems. Approved code of practice and guidance'.

Decant facilities

11.181 Ideally, decant facilities should be readily available where, for example, construction/refurbishment works are being carried out. Where practical, consideration should be given to vacating areas and screening of clinical areas. If decant facilities are not available then additional cleaning and regular inspection will need to be put in place along with the use of ventilation or pressure differentials to control the work area and avoid cross contamination.

Replacement of internal surfaces

11.182 Regular inspections of surfaces are important to ensure that smooth, easy to clean surfaces are maintained. Damaged surfaces can harbour dust and contamination and soft difficult to clean finishes should be avoided.

Redecoration

11.183 Where practical, whole areas should be decorated at the same time. If not practical, consider smaller areas of work that are screened off from the rest of

the area. Finishes which are difficult to clean should be replaced with suitable alternatives, smooth, easy to clean surfaces.

12. Demolition

- 12.1 Work of this type will require a building warrant and a Decommissioning Team should be established. The Decommissioning Team needs to include a Planning Supervisor and consideration should be given to the likely spread of dust/dirt which the works will cause. Issues such as limitation of airborne fungal contamination need to be considered.

Decontamination of buildings and equipment

- 12.2 Buildings should be thoroughly cleaned after all furniture etc has been removed. There are some airborne decontamination methods which should be considered to minimise the risk prior to demolition. Equipment should be decontaminated prior to reuse elsewhere or final disposal.

Effect upon adjacent healthcare premises

- 12.3 There are health and safety issues which the Decommissioning Team will have to consider with the advice of the Planning Supervisor. Additional cleaning may be required due to the additional dust likely to be caused. Ventilation filters in areas likely to be subject to a high airborne dust load should be checked and changed if necessary, prior to demolition works starting. An overloaded filter can collapse and cause contamination. Filters should also be checked and changed if necessary once work is complete.

Planning for demolition works

- 12.4 Prevailing wind direction and the distance of the demolition works from occupied areas are key considerations when planning demolition works.
- 12.5 The demolition Project Plan should contain details of measures to be taken to minimise contamination of other areas. The person responsible for each control measure should also be named.
- 12.6 On completion of the work, the success or otherwise of the control outcomes should be formally assessed and the lessons learned disseminated widely, including outwith the organisation, for the benefit of colleagues involved in similar projects.

13. Decontamination prior to disposal of site

Decontamination of building and site

- 13.1 Any site to be disposed of will need to be clean and free of infection risk. It may be necessary to use a decontamination system such as fumigation. If such a procedure is carried out, records of site decontamination need to be kept and made available on request. Advice on disposal policies should be gained from Estates staff. Ash and clinker may also have been buried on the site and there may have been fuel leaks etc. These need to be identified to prospective purchasers.

Decontamination of land

- 13.2 There have been instances of hospital sites with dangerous materials such as clinical waste and asbestos disposed of within the hospital site. Decontamination of the site intending to be disposed of is the responsibility of the healthcare body. Contaminated land may need to be disposed of as special waste and can be extremely expensive as the soil removed must also be classified as special waste.
- 13.3 Current legislation constrains producers of waste to manage and dispose of it by means consistent with the hazard posed by the waste, through facilities approved for treatment of the particular category of waste e.g.
- ash and clinker may have been buried on site;
 - fuel stored may give rise to fuel leaks;
 - old sewers if not properly closed off can back flow into remaining premises and cause contamination with effluent.
- 13.4 Burying or long-term storage of waste on a healthcare site is likely to constitute an offence. Issues need to be identified to prospective purchasers.

14. Appendices

Appendix 1: Equipment Groups

Appendix 2: Glossary

Appendix 1: Equipment groups

Equipment supplied for new building schemes can be one of four categories:

Group 1

Group 1 items are specified at the design stage and are supplied and fixed under the terms of a building/engineering contract and funded within the works cost. These are generally large items of plant/equipment which are permanently wired/installed, i.e.

1. Specialised equipment items best suited to central purchasing arrangements.
2. Excluded from this Group will be items subject to late selection due to considerations of for example, radio diagnostic equipment. Taps and basins also fall into Group 1 equipment.

Group 2

Items which have implications in respect of space/construction services and are installed under the terms of building engineering contracts, but are purchased by the Client under a separate equipment budget e.g.:

- paper towel dispensers;
- soap/scrub dispensers;
- shelving;
- washer/disinfectors;
- washing machines.

Group 3

Items which have implications in respect of space and/or construction/engineering services and are purchased and delivered/installed directly by the Client e.g.:

- small refrigerators;
- furniture;
- ventilators;
- monitors;
- trolleys.

Group 4

Items which may have storage implications but otherwise have no impact on space or engineering services e.g. medical devices.

Appendix 2: Glossary

Airborne Infection: A mechanism or transmission of an infectious agent by particles, dust or droplet nuclei suspended in the air (Last, 1995).

Aspergillosis: A fungal infection caused by *Aspergillus spp.*, commonly found in soil, decaying vegetable matter, damp cellars, building materials and ventilation systems. The most common mode of transmission is by the airborne route, for example dispersal of contaminated aerosol. In fact, airborne *aspergillosis* is a risk to patients with highly compromised immunity.

Contact transmission has been reported, for example a recent cluster of cases in Manchester suggested a contaminated stockinette was the source of infection. The density of *Aspergillus spp.* spores in hospital air is increased considerably during construction, and there is evidence that healthcare associated aspergillosis is caused by contamination of ward air from outside. Hospital ventilation systems can draw in contaminated outside air because of either malfunction or inadequate mechanical ventilation and air filtration (Manuel and Kibbler, 1998; Cornet et al, 1999; Mahieu et al, 2000; Richardson et al, 2000; Thio et al, 2000).

Cleaning: The process of physically removing contamination including soil, dust, large numbers of micro-organisms and the organic matter that protects them.

Cohort Nursing: Placing patients infected with the same micro-organism (but with no other infection) in a discrete clinical area where they are cared for by staff who are restricted to these patients.

Communicable disease: An illness due to a specific infectious agent or its toxic products that arises through transmission of that agent or its products from an infected person, animal, or reservoir to a susceptible host, either directly or indirectly through an intermediate plant or animal host, vector or the inanimate environment.

Contact: Association with an infected person or animal or a contaminated environment such that there is an opportunity to acquire the infection.

Contamination: The presence of an infectious agent on a body surface; also on or in clothes, bedding, toys, surgical instruments or dressings, or other inanimate articles or substances including water and food. Contamination does not imply a carrier state.

Cross-infection: An infection either due to a microbe that came from another patient, member of staff or visitor in a healthcare establishment or due to a microbe that originated in the inanimate environment of the patient.

Decontamination: The combination of processes which include cleaning, disinfection and sterilization used to render a reusable medical device safe for reuse on patients and for handling by staff.

Dead-legs: In a water supply and distribution system, pipes that are capped off or rarely used, or regions of pipework which are not scavenged by flow.

Disinfection: The reduction of the number of micro-organisms to a safe or relatively safe, level but not usually the destruction of pores.

Fomites: Articles that convey infection to others because they have been contaminated by pathogenic organisms. Examples include hospital equipment, instruments, kidney dishes, hospital bed tables.

Fungi: Unicellular, multicellular or syncytial spore-forming organisms that feed on organic matter; includes yeasts and moulds (Baril, 2000). The most common fungal infections are caused by *Candida* spp. (see, for example, O'Connell and Humphreys, 2000).

Healthcare associated infections: Infections that a patient acquires during a visit to, or that is related to a stay in a healthcare facility.

Heat labile: That which is likely to be damaged or destroyed by the normal heat disinfection process.

Iatrogenic infection: Infection that arises as an unwanted consequence of a medical intervention.

Immunocompromised patient: A patient whose immune response is deficient because of an impaired immune system.

Indirect contact: A mode of transmission of infection involving fomites or vectors. Vectors may be mechanical or biological.

Non-touch (taps): Includes foot or knee-operated, or infrared sensor taps.

Pathogen: A bacterium, virus, or other micro-organism that can cause disease.

Prion: An infectious protein to which several so-called slow virus diseases (for example Creutzfeldt-Jakob Disease, scrapie and bovine spongiform encephalopathy) are attributed. The word was coined in 1982 by S. Prusiner, from *proteinaceous infectious particles*, reversing the order of the vowels.

Reservoir (of infection): Any person, animal, plant, soil or substance, or a combination of these, in which an infectious agent normally lives and multiplies, on which it depends primarily for survival, and where it reproduces itself in such a manner that it can be transmitted to a susceptible host: the natural habitat of the infectious agent (Last, 1995; Dancer, 1999).

Single room / En-suite single room / Isolation room/Bay: For the purposes of this document, the following terminology is used:

- 1) **Single room:** This is a room with space for one patient and usually contains as a minimum: a bed; locker/wardrobe and clinical hand-wash basin, plus a small cupboard with worktop.
- 2) **En-suite single room:** As above but with any combination of en-suite facility i.e. shower, shower and toilet, bath and toilet or just toilet etc.
- 3) **Isolation room:** As in 1 and 2 but with either negative pressure ventilation for infectious patients (source isolation) or positive pressure for immunocompromised patients (protective isolation). May or may not have a lobby or en-suite facility.
- 4) **Bay:** Any room that contains more than one bed (i.e. two-bedded bay; three-bedded bay; four-bedded bay; six-bedded bay, etc) which may or may not have en-suite facilities.

Spore: Some species of bacteria, particularly those of the genera *Bacillus* and *Clostridium*, which are significant cause of infection in humans, develop highly resistant structures called spores when they are exposed to adverse conditions, such as a lack of nutrients or water. Spores are resistant to disinfectants and to high or low temperatures. They may remain viable for many years but when the environment conditions improve the spores germinate and the bacterial cell inside starts to multiply again.

Sterilisation: The process of removing or destruction of micro-organisms including spores.

Thermostatic mixing valves: Valves that mix the hot and cold water of the system to provide water at a predetermined temperature.

Transmissible Spongiform Encephalopathy (TSE): Name for a group of fatal degenerative brain diseases that causes sponge-like abnormalities in brain cells. TSE diseases are associated with accumulation of abnormal prior protein in the brain.

Transmission: Any mechanism by which an infectious agent is spread from a source or reservoir to a person. Modes of transmission of infection include direct transmission involving direct transfer of micro-organisms to the skin or mucous membranes by direct contact; indirect transmission involves an intermediate stage between the source of infection and the individual, for example infected food, water or vector-borne transmission by insects; airborne transmission involving inhaling aerosols containing micro-organisms, for example legionnaires' disease or tuberculosis (Last, 1995; Donaldson and Donaldson, 2000).

15. References

These articles, publications and books were current at the time this document was produced. Anyone using this SHFN should ensure that they refer to current versions of any references.

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