Scottish Health Planning Note 28

Facilities for cardiac services: design and briefing

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About this series

The Scottish Health Planning Note series is intended to give advice on the briefing and design of healthcare premises in Scotland.

These Notes are prepared in consultation with representatives of NHSScotland and appropriate professional bodies. Health Planning Notes are aimed at multi-disciplinary teams engaged in:

- designing new buildings;
- adapting or extending existing buildings.

Throughout the series, particular attention is paid to the relationship between the design of a given department and its subsequent management. Since this equation will have important implications for capital and running costs, alternative solutions are sometimes proposed. The intention is to give the reader informed guidance on which to base design decisions.

This document has been adapted by the Property and Environment Forum Executive from the core text provided by NHS Estates, England.

Aims and objectives

This document is aimed at a broad audience and covers the subject from its clinical and operational roots through to the design and equipping of cardiac facilities.

The key role is to advise on the built environment required to implement the planning, construction, commissioning and operation of a new or upgraded facility.

This document also aims to employ innovation in the built environment, advancing the modernisation of diagnosis and treatment, and raising the quality of service in order to provide an environment that is genuinely sympathetic to the needs of all users and recognises the broad range of activities present and their significance.

Overview of the subject

Coronary heart disease is probably the most common cause of premature death in Scotland. The Scottish Executive regards reducing the incidence and impact of coronary heart disease (CHD) within the population as a major priority.

Cardiac centres, cardiac units in district general hospitals, and primary care will all require to link to form a network of cardiac care. The underlying principle of

this approach is that the service should be patient-centred at the point of delivery.

The Scottish Executive Health Department will set national standards for preventing and treating CHD. It will define service models and establish initial milestones, goals and performance indicators against which progress can be measured. In order to deliver these standards, investment in services and facilities will require to be significantly increased over the next ten years.

In support of such investment, this document provides guidance on the planning and design of facilities for the diagnosis, treatment and care of people suffering from CHD. This includes facilities at the tertiary and secondary level, as well as in the primary care and community sectors.

The patient experience

The technological nature of cardiac services can often be an unpleasant and distressing experience for patients and their carers. It is of the utmost importance in designing facilities that the patient experience is taken into account. The emphasis should be on providing a pleasant and comfortable environment for patients at all times.

Structure

This document is concerned primarily with adult disease. Subsequent documents will cover facilities for paediatrics and also examine the special requirements of transplantation surgery.

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1. Scope of SHPN 28

Introduction

Coronary heart disease

1.1 Coronary heart disease (CHD) is the most common cause of premature death in Scotland, and indeed the UK, as well as a significant cause of ill health and disability. It is a condition that makes a significant impact upon every aspect of an individual's life, including his or her quality of life, future employment and personal relationships, as well as increasing the risk of his or her dying early. CHD affects 500,000 people in Scotland with about 180,000 people suffering symptoms at any one time with that number increasing at present. While CHD is the most common cardiac disorder, a range of others also occurs. Among these are a number of congenital disorders, often seen first in neonates or detected by ultrasound prior to birth. In adults, diseases affecting heart valves are seen, as are conditions that affect the neurological conducting tissues in the heart; these are important to the maintenance of regular contractions. The pericardium, two thin tissue layers which envelope the heart structure, is subject to a range of inflammatory disorders that may be associated with infections such as tuberculosis and rheumatic fever. The myocardium and endocardium may also become affected by disease associated with infection or as a complication of CHD.

1.2 Much can be done to reduce the suffering caused by CHD and to stop it developing in the first place. It has long been recognised that timely and effective treatment can reduce suffering and the risk of death from CHD, and a more systematic approach to the delivery of care can ensure that all those likely to benefit do gain access to appropriate services. The Scottish Executive Health Department regards reducing the incidence and impact of CHD within the population as a major priority. *'Our National Health: A plan for action, a plan for change'* sets out their targets which includes the CHD Task Force producing a national plan.

Areas for concern

1.3 NHSScotland has identified a number of areas that are currently giving concern, areas in which concerted action is now required if the objectives are to be achieved:

- rates of CHD presently vary according to social circumstances, gender and ethnicity, and differences across the social spectrum have been growing;
- many people are not receiving, or acting, on advice and help that could stop them developing CHD in the first place;

- there is evidence that there are marked inequalities in the provision and quality of services across different regions in Scotland.

Implications and challenges for the health estate

1.4 These objectives have very considerable implications for the health estate and present a number of significant challenges to the rationality and adequacy of present arrangements. Key quality issues are identified within this advice and there are special implications for the size of coronary care units (CCU) and intensive therapy units (ITU). Changes to the diagnostic and therapeutic facilities provided are also recommended.

Patient centred approach

1.5 An underlying principle of this approach is that the service should be patient centred at the point of delivery. A very high level of priority needs to be given to relevance and continuity. This level of priority is also required to ensure that patients receive the right advice, investigation and treatment when they need it and as close to home as possible. In design work, consultation with patient groups is recommended as part of the overall research process.

1.6 The need to reflect the required standards in relation to patient focused services poses a particular challenge to the skills of service planners and facilities designers, especially those working in long established centres. A number of these challenges are discussed in Section 2.

Location of services

1.7 Most specialist cardiac centres are, by necessity, located in large urban centres that serve geographically extended suburban and often more sparsely populated rural areas. This may not present an overwhelming difficulty for patients following a conventional referral route from the local community or even further afield, where outreach services, clinics and local diagnostic centres may fill a substantial part of the gap. The use of telemedical services in such applications as ECG analysis may also help to resolve some geographical difficulties. However, there are inequalities of access to appropriate services for those living in the more remote areas who require investigation and treatment in an emergency. Some areas in Scotland have tried to address this problem, notably Grampian, Skye and Dumfries and Galloway. There, patients would most likely be taken to a CCU or accident and emergency (A&E) department in response to chest pain.

Rationalisation of provision

1.8 Some procedures, particularly those concerned with revascularisation (e.g. coronary artery bypass grafting) of the patient, require a high degree of skill, not only from the surgeons but also from the whole team caring for the patient. There is a growing body of evidence that suggests that competence in these difficult procedures is only maintained when a sufficient number of procedures are carried out in the 'institution' on a yearly basis. Continuous professional

development (CPD) schemes from learned bodies and associations reflects this.

1.9 Some centres or departments may have developed to provide more immediate access to these services, and may also be well used by their targeted catchment populations, particularly in terms of CCU provision. The patient throughput in these centres may not meet the levels of consultant staffing that delivery of the standards now requires. In the short term, this may see two or more centres collaborating to meet targets. However, in the medium and long term, some NHS Boards may favour centralisation of some services.

Expansion and re-organisation of services

1.10 Almost all of the existing centres will be affected by the proposed standards and targets for reductions in waiting times, for key investigations and the increase in revascularisation procedures. Some centres may require additional coronary angiography laboratories and operating theatres to be built using capital to be invested in the service identified in the 'plan for change'. In some cases, this expansion of facilities may be accomplished by the creation of entirely new centres. Some of these will be on, or adjacent to, existing hospital sites. In some instances, however, the expansion may have to take place locally, which may affect other, not necessarily cardiac-related, clinical and support services already on-site. The use of new build may be required.

Rapid access chest pain clinics

1.11 Chest pain clinics are hospital based services that provide direct assessment for patients with suspected angina or chest pain. In the majority of cases, they will be targeted at patients presenting at GP clinics with the onset of chest pain who have no history of cardiac diseases or heart disease. In some instances, the clinics may only be open to patients from specific age groups. The rapid access chest pain clinics will provide patients with specialist advice, allow a range of basic tests to be undertaken, such as ECG, and assist in the organisation of further examinations and treatment as appropriate. CCU or A&E departments will, on the other hand, deal with severe instances for triage and the possible administration of thrombolytic (clot dispersing) drugs.

1.12 NHSScotland has prioritised developing rapid access chest pain clinics within the service. Waiting time goals have also been set for the year 2002.

1.13 In order to provide these, clinics may require the provision of new or re-organised facilities. The use of serviced accommodation solutions is also envisaged.

Other challenges

1.14 There are a number of other requirements which demand action and for which guidance is included in this document. This reflects the challenge of the range and prevalence of cardiac disorders today.

Effectiveness and efficiency

1.15 There is a need to reflect current healthcare evidence about the various ways in which planning and design may impact upon the effectiveness and efficiency of a service, and ultimately upon clinical outcome or staff and/or patient safety. This relates to staff and patient journeys, the layout and equipping of key diagnostic and treatment facilities and physical relationships between services and facilities.

Health and safety

1.16 Current requirements relating to health and safety, in particular those that relate to radiation protection and electrical installations must be taken into account. This is to ensure that output from the ever more complex electronic scanning and signalling devices used in cardiology, work appropriately and reliably in the healthcare engineering environment. Legislation in radiation protection has been recently revised both in general (ionising radiation regulations) and patient specific terms. The emphasis is on risk control and dose limitation related to benefit.

Infection control and bio-decontamination

1.17 Current requirements for control of infection in relation to patients and staff must be taken into account. In addition, the bio-decontamination or safe disposal of used instruments, equipment or materials is of considerable importance and subject to improvement. Designers will need to consider the provision of facilities for the safe storage of decontaminated and sterilised surgical instruments, materials, etc. The appropriate disposal of instruments and other devices that cannot be recycled must be in accordance with agreed NHSScotland policies, local protocols and operational requirements.

1.18 There is also need to design and plan facilities that minimise the infection risk to patients from interventional procedures, particularly those concerned with revascularisation. The design of the facilities should be sympathetic to the overall clinical objectives and yet flexible so as not to inhibit clinical development. Refer also to Scottish Health Facilities Note (SHFN) 30 ‘Infection control in the built environment - design and planning’.

Clinical evolution

1.19 There is a need to plan for significant rates of change and some limited obsolescence in both the techniques and in the facilities and equipment that must be deployed in support of those techniques within every specialist centre. In high technology and science dependent specialities like cardiology, it is not always clear where the principal generators of change are located. For example, the need to bring about improvements in clinical technique, developments in imaging technology or information systems and discoveries in the basic and/or clinical sciences have all had a significant impact on the development of the specialty.

Aims of the document

1.20 This SHPN is concerned primarily with adult disease. Subsequent documents will cover paediatric disorder and the special requirements of transplantation surgery. The aims of this document are as follows:

- to provide guidance on the planning and design of facilities for the diagnosis, treatment and care of people suffering from CHD;
- to assist key decision-makers in the organisations, institutions and agencies who contribute to, or are responsible for, guiding cardiac service development at national and regional level, as well as assisting those responsible for procuring those services locally;
- to be supportive of approaches to the planning and design of services and facilities that meet immediate essential needs, while at the same time recognising the need to build in strategies for dealing effectively with pressures for growth and change as they might arise in the future.

Planning and design

1.21 The condition of the healthcare estate may in some instances be a significant constraint in achieving required aims. This document therefore provides guidance on the planning and design of facilities for the diagnosis, treatment and care of people suffering from CHD. It promotes and explains the concept of cardiac facilities design as an integral part of a comprehensive approach to the delivery of care, setting it within the context of a healthcare system that is continually evolving to meet the nation's changing healthcare needs. As with previous guidance published by NHSScotland, there is a strong emphasis upon the provision of information for project and design team members. It is hoped the content will also be useful throughout the clinical cardiac community, including those responsible for the planning and delivery of services and those operating in the voluntary and private sectors.

1.22 Notwithstanding the complex and highly technical nature of cardiac service delivery, it cannot be too strongly stated that the achievement of quality in every aspect of the built environment to which patients, their carers and the staff that look after them are exposed is as important a contribution to therapeutic processes as the achievement of effective solutions to the operational and technical problems that cardiology services present. For this reason, this document is not intended to promote any particular design solution; there is no one 'blueprint' for good cardiac facilities design. Rather it offers a framework of guiding principles supported by technical information that can be interpreted and acted upon to produce creative and innovative solutions that suit local circumstances and requirements, and which may also contribute to a greater understanding of the relationship between built environment and clinical processes.

Planning scenarios

1.23 Matching resources to requirements within a complex and evolving system often means that decision makers must steer a deliberate course between what may be the conflicting demands of a number of different planning scenarios. In many cases, this process can be made more difficult because an assessment of the likely long-term impact of those different scenarios upon service delivery may lie outside the scope of a purely function-based analysis. For this reason, this guidance is designed to assist key decision makers in the organisations, institutions and agencies who contribute to or are responsible for guiding cardiac service development at the national and regional level, as well as assisting those responsible for procuring those services locally.

Impact of change

1.24 Being strongly research, evidence and technology based, cardiology services exhibit significant but not overwhelming change over comparatively short periods of time, with pressures for change generated in different parts of the system simultaneously, though usually unpredictably. Since the relationship between treatment/investigative technique, clinical research and technology development is so involved, changes in the balance of that relationship may be critical in determining how, at any given time, services may best be organised, accommodated and delivered. This guidance is therefore strongly supportive of approaches to the planning and design of services and facilities that meet immediate essential needs, while at the same time recognising the need to build in strategies for dealing effectively with pressures for growth and change as they might arise in the future.

Audience

1.25 This SHPN has the following target audiences:

- project and design teams;
- directors, managers, clinicians, specialists and care staff in service-providing organisations in the public and private sectors;
- members of the charitable and voluntary sectors;
- the medical engineering industry.

Multi-disciplinary teams

1.26 The guidance in this document is aimed at an audience that is substantially wider than that which has traditionally been targeted i.e. estates and engineering staff. There are two reasons for this:

- it offers a model of service delivery that is very broadly based, and which places a very strong emphasis upon continuity of care across a very wide range of service locations. It promotes the concept of a patient centred and

locally led structure for the organisation of care services, and encourages participation of professional groups and other organisations. For these groups to participate effectively in the planning of services and the buildings that support them, they must be given guidance that is consistent with and of similar quality to that which, in the past, was only of interest to health estates professionals responsible for the design and planning and possibly procurement of the built environment through which these programmes flow;

- issues relating to the estate and issues relating to the delivery of services are seen as too closely interdependent to be discussed separately.

Charitable and voluntary sectors

1.27 Finally, it is important to recognise the role that the charitable and voluntary sectors play in the provision of clinical, care and support services to patients suffering or recovering from any form of cardiac disease. This support is often extended to carers. For this reason, it is hoped that some parts of this document, and in particular the contents of Section 3, will be of interest to this group.

Scope and structure of the document

Scope

1.28 This document offers guidance on the planning and design of services and facilities for people, in virtually all cases adults, suffering from or at risk of cardiac disorders, including planning for the provision of services and facilities in the primary and community sectors. It also discusses the service planning and resource implications of programmes for the prevention and early diagnosis of cardiac disease, and for its management in post-treatment and in chronic phases.

1.29 The document offers support for the concept of a comprehensive and integrated model of service delivery. Emphasis is therefore placed on the contribution of the non-hospital based and non-NHSScotland components of that model, and on the service delivery context within, in which a new or extended facility must function.

1.30 Notwithstanding the importance that is attached to the role of the primary care and community sectors, the substantial part of this guidance relates to the planning and design of hospital based services and facilities at the secondary and tertiary levels, in district general and teaching hospital settings. The contents of ‘minor’ and ‘major’ cardiac service units are defined. These may not always reflect traditional boundaries between levels of service but are more patient focused in their development.

Structure

1.31 It is recognised that not all of the members of the extended readership to which this document is addressed require access to all of the information, nor will all require it in the same degree of detail. The document is structured to reflect those different requirements as described below:

- Section 2 provides general information on the nature of cardiac disease and will be of general interest to the whole of the target readership;
- Sections 3–6 discuss the delivery of cardiac services in relation to primary, secondary and tertiary settings and will be of interest mainly to directors, managers, clinicians, specialists and care staff in 'service providing' organisations in the public and private sectors and members of the charitable and voluntary sectors;
- Section 7 describes the services and facilities that are required to deliver broader cardiac service delivery models at the tertiary level of care. It will be of interest mainly to members of planning and design teams involved with specific projects at the tertiary level;
- Section 8 describes engineering services related to the provision of clinical cardiac services. It includes a description of the specific requirements of diagnostic imaging devices.

Exclusions

1.32 The following areas, which form part of the broad spectrum of cardiac services, are explicitly excluded from this guidance:

- services and facilities relating to organ transplantation; and
- facilities for the delivery of cardiac services to children (to be covered in SHPN 28 Part 2, to be published later).

1.33 In the following areas, the guidance that is provided is of a general nature only:

- facilities for which guidance is already available in NHSScotland and which do not require modification if accessed by patients requiring cardiac services; and
- non-health related facilities in the primary care and community sectors.

Terminology

Cardiac service provider classification for estates purposes

Major cardiac centre

1.34 The major centres in Scotland, excluding those concerned solely with diseases in children and young people, include some, if not most of the following capabilities:

- care for patients with suspected CHD and heart attack in a fully equipped and properly staffed CCU;
- full range of investigative procedures supported by current evidence where applicable. This is extended to include all of the common adult cardiac diseases;
- minimal invasive therapy and interventional techniques to include percutaneous transluminal coronary angioplasty (PTCA) and stenting as minimum requirements;
- appropriate outpatient facilities and inpatient nursing;
- electrophysiological studies and associated oblation techniques;
- pacemaker fitting and follow-up facilities for both temporary and permanent devices;
- surgical facilities for CHD, valve replacement and a range of other techniques;
- ITU and ICU in support of surgical and interventional facilities;
- inherent research potential and the ability to maintain full contemporary clinical standards coupled with a continuous development programme related to patient care techniques;
- high level of interface with other care providers;
- record-keeping capabilities that are robust and secure;
- hospital and community based rehabilitation programmes for cardiac sufferers;
- teaching facilities for internal staff and those contributing at the primary and secondary care levels.

1.35 Additional capabilities are found at some centres with special interests;

- heart and/or heart/lung transplantation. To include facilities for the nursing of immuno-suppressed patients;
- full teaching facilities for under and postgraduate education in cardiology, cardiac surgery and related disciplines;
- care for patients with continuing congenital cardiac disorders.

Specialist paediatric centres

1.36 Scotland has one of these centres based in Glasgow, which has the following capabilities:

- care for neonates and children in a fully equipped and properly staffed paediatric intensive care unit (PICU);
- full range of investigative procedures supported by current evidence for the care of neonatal and young patients;
- minimal invasive therapy and interventional techniques to include shunt insertion and septal closure techniques as minimum requirements;
- appropriate outpatient facilities and inpatient nursing properly constructed for the care of young people;
- surgical facilities for the correction or alleviation of congenital heart and cardio-pulmonary diseases;
- inherent research potential and the ability to maintain full contemporary clinical standards coupled with a continuous development programme related to neonatal and young patient care techniques;
- hospital and community based rehabilitation programmes for children;
- teaching facilities for internal staff and those contributing at the primary and secondary care levels;
- schooling facilities for children;
- counselling services for children and relatives as a part of an overall care and accommodation commitment.

Smaller or minor cardiac care centres

1.37 These centres have the following capabilities:

- CCU for the reception and initial care of those suffering from CHD and associated conditions;
- range of investigative procedures to include ECG and echocardiological investigations;
- appropriate outpatient facilities;
- high levels of interface with other care providers;
- record keeping capabilities that are robust and secure;
- pacemaker fitting and follow-up facilities at least for temporary devices;
- hospital and community-based rehabilitation programmes for cardiac sufferers;
- teaching facilities for internal staff and others contributing to patient care;
- counselling services for adults and relatives as part of an overall care programme.

1.38 A glossary of other operational, clinical and technical terms is provided in Appendix 1.

The needs of patients and relatives or carers

1.39 The influence of patients' requirements on cardiac building design is clearly a matter of real interest in the business of improving the built environment and standards of patient care. There is a need to ensure that patients are cared for in an appropriate and sensitive way, this requirement may often extend to embrace the needs of patients' relatives and carers.

1.40 This is particularly true in many of the cardiac diseases, which can be debilitating and will tend to increase the patients' dependence upon those around them, and highlights the need to consider rooms for day and possibly overnight or longer term stays by relatives and carers. Frequently, these will need to be located close to the CCU or ITU.

1.41 Design teams are strongly advised to seek the advice of national or local patient support groups in ensuring that the facilities provided are appropriate for both patient and relative as and when this is achievable within the design. When new units are contemplated, the scope for such consultations is likely to be extensive and the benefits considerable.

1.42 The British Cardiac Patients Association (BCPA) may be consulted for further advice on patients' preferences and needs.

2. Overview of heart disease

What is heart disease?

2.1 Heart disease can be thought of in two categories: congenital disorders and those that are acquired during life, possibly influenced in terms of risk by lifestyle choices such as smoking or poor diet. The possibility that acquired disease may also have a genetic component is increasingly established in some instances. Taken together with vascular and pulmonary diseases, which are often related, this group is responsible for a large proportion of premature deaths in much of the Western world.

Congenital disorders

2.2 Congenital disorders most commonly appear in the foetal heart and are seen in in-utero examinations or observed in neonates or young babies. The diseases cause mechanical problems with the movement of the heart and its ability to function as a dual pump, supplying blood to the lungs for oxygenation and to the rest of the body for life sustaining purposes. The best known disease group relates to septal defects in which the wall between the left and right sides of the heart is defective, resulting in the mixing of blood passing to the lungs with that circulating the rest of the body. This often results in blue baby syndrome, the colour being caused by poor blood oxygenation. Many of these conditions are treatable and the involvement of intervention with the use of imaging systems is growing rapidly.

Coronary heart disease

2.3 Of the cardiac diseases occurring in the adult population, blockage or restriction of the coronary arteries, coronary heart disease (CHD), is the most common and, in national terms, the most damaging. Restriction of blood flow in these arteries due to the accumulation of plaque results in reversible, or indeed irreversible, damage to the cardiac muscle and the nervous tissues, which are very important to maintaining a regular cardiac rhythm or heartbeat. This damage is referred to as myocardial infarction (MI).

2.4 This document, while largely relating to coronary heart disease and heart attack, also recognises other diseases such as valve disorders, cardiac infections and congestive heart failure.

Who suffers from it?

Cardiac infection

2.5 A range of cardiac disorders may arise as a result of complex disease processes which involve infection as a key factor. Rheumatic fever and tuberculosis (TB) may result in inflammatory conditions such as pericarditis which involves two thin layers of tissue which envelope part of the cardiac structure. Diseases of the myocardium and endocardium may result from other conditions or be caused more directly by infection.

Coronary heart disease

2.6 CHD is most commonly seen in middle-aged and elderly people. The peak age is greater in women. The disease is slightly more common in men than women, although the idea that this is principally a disease in men is false.

2.7 There is mounting evidence to suggest that lifestyle issues and health at work factors may be of substantial importance in terms of the likelihood that any given individual will contract the disease. In particular, smoking, an excessively fatty diet and lack of exercise are all thought to be highly significant. As a result many initiatives from organisations such as the British Cardiac Society and the British Heart Foundation focus on health education, anti-smoking campaigns and the general need for vigilance.

Can it be prevented?

Congenital disorders

2.8 It is difficult to prevent congenital disorders in children. Ultrasound scanning before birth permits the obstetric team to prepare for difficulties at birth, and may under some circumstances present parents with the challenge of contemplating a termination. The full implications of this and other aspects of paediatric heart disease will be covered in SHPN 28: 'Facilities for Cardiac Services Part 2', to be published later.

Coronary heart disease

2.9 For adults, the prevention of CHD through health education related to lifestyle is a valid and effective approach. While comprehensive cardiac health screening is not provided in the UK, some benefit may be derived from services offered as a part of 'well man' or 'well woman' schemes at the primary care level, including health education, simple measurement of blood cholesterol and blood pressure monitoring.

2.10 However, when a patient experiences angina or chest pains, the regular use of drugs, including aspirin, can be an effective treatment or prophylactic, which may reduce the risk and severity of a heart attack.

How is coronary heart disease diagnosed?

Early indications

2.11 The diagnosis of cardiac disorders in adults starts from marked symptoms such as the appearance of chest pain. The electrocardiogram (ECG) which shows the electrical signal of the patient's heart is the most commonly used early test, although not all heart disease sufferers will present with ECG abnormalities. Generally, ECG waveform abnormalities are a good first indication of heart disease.

Electrocardiography

2.12 Diagnosis will ordinarily progress through more elaborate forms of ECG, which may involve subjecting the patient to drug or exercise induced stress. Holter ECG involves long term monitoring over a day or so to look at how the heart copes with day-to-day demands. Over and above this, the patient may be referred for a special ultrasound examination known as an echocardiogram, which permits the anatomy and movement of heart structures to be assessed. Most commonly, the imaging probe is placed adjacent to the patient's skin, but in some instances an internal probe within the oesophagus is needed. Clearly, such examinations require a special hospital environment.

Nuclear cardiology

2.13 Patients with increasingly confirmed disorders may progress to receive nuclear cardiology examinations. These are performed in a special radiation safe environment, where a radioactive pharmaceutical is used to image the heart and check for damage or MI that may be caused by disease. At present there is limited use of this facility in Scotland.

Coronary angiography

2.14 The 'gold standard' diagnostic technique for CHD is coronary angiography, which requires the use of a specially built X-ray machine to examine the coronary arteries directly following the injection of a dye that absorbs X-rays in a specific way. This is a very special examination, which requires the provision of a suite combining the attributes of an operating theatre with the technological profile of a sophisticated imaging room. This technique is standard in major cardiac centres and permitted in minor centres, provided that a range of standards can be met.

Electrophysiology

2.15 Some heart conditions may have their origin or complications in the conducting or nervous tissue of the heart. These conditions require a special investigation, conducted in the angiography laboratory or catheterisation suite. This examination, known as electrophysiology, involves placing electrodes on the surfaces of the heart under X-ray control and is both sophisticated and time-consuming. Where the technique is to be applied, there will be special design implications for the angiography suite.

Computed tomography and magnetic resonance imaging

2.16 Both computed tomography (CT) and magnetic resonance imaging (MRI) techniques are being developed to image the heart chambers, valves and coronary arteries. Although progress has been good, neither modality has made significant inroads into the dominant position of angiography as the gold standard CHD diagnostic technique. However, planners and designers are advised to consider opportunities and contingencies to ensure both present and future access to CT and MRI for cardiac diagnosis. This may, in some highly specialised centres, give rise to the need for dedicated CT/MRI equipment, but for the moment this remains unusual.

How is coronary heart disease treated?

2.17 Treatment of CHD essentially falls into the following categories

- drug based treatments;
- electrical treatments for arrhythmia and the use of implantable pacemakers;
- percutaneous transluminal coronary angioplasty (PTCA);
- cardiac surgery.

Drug-based treatments

2.18 Drug-based treatments are coupled with periods of observation as an inpatient, often in a coronary care unit (CCU). This is a specially designed unit with features that permit not only high levels of observation but also the provision of emergency care if needed. The use of thrombolytic drugs that counter blood clot formation is a key element of the care strategy and has been demonstrated to be effective in clinical trials.

2.19 Following initial hospital care after a heart attack, most patients receiving medical care for cardiac conditions are discharged and dealt with adequately on an outpatient basis with close supervision.

Pacemaker and related treatments

2.20 These treatments assist the patient by stabilising the electrical stimulus of the heart so as to restore or maintain cardiac rhythm. The correction may be given externally or by the use of a pacemaker with implantable electrode. Both temporary and permanent pacemaker implantation is utilised. The correction of some heart rhythm abnormalities by the application of techniques such as cardioversion may be grouped in this area of activity.

Percutaneous transluminal coronary angioplasty (PTCA)

2.21 PTCA is now a well accepted procedure and is increasingly being developed, although there continues to be some controversy as to the importance of backup cardiac surgical facilities. The recommendation that PTCA should only be undertaken where there is immediate access to cardiac surgery is accepted in Scotland. PTCA is a technique in which a catheter, tipped by an inflatable balloon, is fed into the patient's coronary arteries through arteries in the leg or arm. The catheter is steerable by a cardiologist and may be controlled or observed using X-ray angiography equipment. For many patients, PTCA has become the treatment of choice for the re-opening of partly stenosed or restricted coronary arteries and restoring blood flow to the heart muscle and conductive tissues. The technique is both substantially cheaper and less hazardous than the conventional use of coronary artery bypass surgery (coronary artery bypass grafting [CABG]). Also, recovery times are often shorter.

2.22 In recent times, PTCA has been improved by the widespread introduction of stenting, in which a sheath is inserted into the newly expanded artery to hold the walls open and reduce the risk of recurrent narrowing or blockage. The use of radioactive stents is occasionally practised.

Cardiac surgery

2.23 The majority of cardiac surgery is related to a technique in which a vein from the patient's leg, or other source, is used to literally bypass a blockage or narrowing of the coronary arteries. Other surgical techniques include the replacement of defective heart valves and the correction of some congenital abnormalities.

2.24 Bypass surgery is a technically demanding area and requires specialised operating theatre conditions and equipment. A bypass pump will often be used, as may artificial blood oxygenation equipment, in order to allow the patient's heart to be bypassed, stopped and preserved, in some cases, at low temperatures. This permits the surgery to be carried out on a stationary heart.

2.25 Among new techniques being developed, one using a specialised 'octopus' device appears to potentially simplify bypass surgery and may remove the need for a bypass pump and some other technical complications. While valuable, it is unlikely this technique will fully replace conventional CABG methods. Designers should discuss both the current surgery and new developments with

surgical teams in order to ensure that new or modernised facilities can cope with the rapid rate of change in this area.

What is the referral route?

2.26 The majority of patients enter the cardiac diagnosis system by referral from their general practitioner (GP) to a hospital which offers cardiac services in a routine way. Others may be affected by the chest pain or angina at work, while travelling, or in any number of day-to-day situations. Commonly, these patients make their way to their local primary care facilities or alternatively to a coronary care unit (CCU) or accident and emergency (A&E) department; a proportion are brought by ambulance. A&E departments are increasingly equipped and staffed to conduct cardiac assessment or triage followed by the administration of appropriate drugs and close supervision, with possible transfer to a CCU.

2.27 Once within the cardiac care system, a person who is assessed by a clinician or a cardiologist to be in need of a high level of specialist care is referred to the care of a CCU and possibly transferred to other facilities as necessary.

2.28 For a proportion of patients, including some paediatric cases, the treatment of choice is surgery. Cardiac surgery both for CHD and congenital conditions is highly specialised, and the NHSScotland healthcare system provides these services within major cardiac service hospitals and some very high-grade private centres. Referral to a consultant cardiac surgeon is made, ordinarily, by a cardiologist who will have assessed the patient's case.

3. Cardiac services at the primary care and community levels

Introduction

3.1 This Section examines the contribution that organisations and individuals working in the primary care and community sectors of NHSScotland and Local Government make to the delivery of care required for CHD, and the role that the voluntary and private sectors might play in support of that contribution.

3.2 It includes services for the continuing care of adolescents and young adults who may have survived CHD as neonates, infants or young children, or who may have acquired CHD at a particularly early age, but makes only passing reference to the special requirements of patients and their parents and/or carers in that very young age group. Services for children will be dealt with more extensively in SHPN 28: 'Facilities for cardiac services Part 2', to be published later.

3.3 It is clear that the primary care and community sectors have an important role to play in the delivery of CHD services. The increasing role and development of Primary Care Groups and Trusts is a key factor in service delivery for many categories of cardiac patients. The great majority of non-emergency referrals to hospital based cardiology services in district general hospitals and from there to the more specialised cardiac investigations and treatments located in cardiac centres on tertiary referral sites originate in the primary care sector. Much of the success that has been achieved in the development of home based programmes for the care and treatment of those suffering from CHD, including the provision of support for carers, has resulted from initiatives developed jointly by service providers in the primary care and community sectors. Health promotion, including advice on cardiac disease risk reduction, has long been recognised as a key function of organisations and practitioners at the primary care level.

3.4 The future role of telemedicine in supporting co-operative service development is a further important opportunity and relates to the growing move towards a uniform electronic patient record (EPR) shared across all levels of NHSScotland service.

3.5 That being said, there is much that remains to be done. Opportunities for fruitful collaboration between agencies are increasingly recognised, and there is recognition of the challenge in establishing and maintaining joint planning structures and mobilising or ring-fencing resources derived from different budgetary jurisdictions. Sometimes also there are differences in the extent of the mandated remits of the different participants in a multi-agency initiative. For this reason, the next Section provides a brief summary of current Scottish

Executive policy and Health Department expectations and initiatives in the primary care and community sectors.

Services at the primary care and community levels

3.6 Since the progress of primary care and community led services depends upon the mutual agreement and concerted action of a number of independent separately funded agencies that work together by request or referral, effective joint planning machinery is essential.

Local planning structure

3.7 At the hub of local planning machinery for the provision of community services there needs to be a joint consultative committee, made up of members of the Health Board and Social Services committee, with representatives from housing, education, family practitioner committees and the voluntary sector. Such groups will need to work closely with Local Healthcare Co-operatives (LHCC) and Primary Care Trusts (PCT) healthcare providers.

Special issues

3.8 Co-operation between all the groups and advice for the secondary and tertiary levels is essential to ensure good service provision and building design. Special issues may arise, in particular where health, housing and social services boundaries are not co-terminous and managers in different organisations have differing levels of delegated authority, particularly in relation to budgets and approvals.

Approach to the delivery of services

3.9 As has already been noted, NHSScotland proposals will place a considerable stress on the need to achieve continuity of care across the whole spectrum of CHD related services. Primary prevention, early diagnostic and continuing care services are normally provided by organisations and workers in primary care and community services which provide a significant area of focus.

3.10 It is clear that primary care and community services have an important, and in some cases a crucial, role to play. Within that, professionals are expected to act as facilitators and to provide their own specific expertise within a team structure.

Primary care and community levels

3.11 The required standards and service models in which primary care and community services play a leading role in the organisation and/or delivery of services are in the following programme areas:

- reducing the risk of heart disease in the population;
- controlling the risk of CHD episodes in high-risk patients in primary care.

3.12 Those in which primary care and community services play an important supporting or enabling role are:

- heart attack and other acute coronary syndromes;
- stable angina;
- revascularisation;
- heart failure; and
- cardiac rehabilitation.

3.13 The implications for the organisation and location of services and for their delivery are set out below.

Service delivery settings

3.14 It follows from the above that the settings within which primary care and community services may be provided, and the resources that they may need to command, are many and various. Potential settings include:

- the community, home, shopping centre, school and workplace;
- GP clinics, NHS walk-in centres;
- community pharmacies;
- sheltered accommodation for the elderly and other at-risk groups, day centres, nursing homes, etc.;
- community hospitals, long-term care facilities and hospices;
- early diagnostic and screening centres; and
- alternative medicine centres and practice clinics.

Service providers

3.15 It is not possible in a document of this kind to identify all of the service providers who may contribute to the planning of integrated programmes of care and support at the primary care and community levels that are envisaged. Much will depend on the sort of arrangements that are appropriate in the local situation. The following are, however, likely to be key contributors in the majority of cases:

- doctors (GPs and consultants);
- nurses;
- health visitors;
- social workers (field, day and residential);

- health promotion specialists;
- home care organisers;
- occupational therapists;
- physiotherapists;
- psychologists;
- housing managers;
- social security officers; and
- representatives of voluntary organisations, including patient support groups.

Access to supporting services

3.16 Initiatives at the primary care and community levels are supported by services that are normally provided in other settings within the healthcare delivery system. They include:

- ambulance services;
- accident and emergency (A&E) services;
- laboratory services;
- imaging/electro-diagnostic services;
- rehabilitation services.

Planning issues

3.17 Planning issues that must be addressed derive in the main from the need to create a seamless interface between the various components of the community and health services that must collaborate in the delivery of the standards. These in turn derive in the main from the complex structure of local community based services. Responsibility and accountability for the elements of the services are distributed between different tiers of NHSScotland and Local Government.

3.18 Issues arising from differences in the approach, and resources, of the different agencies concerned, may also need to be addressed.

3.19 The issues that are likely to be addressed under this heading may extend to or encompass any or all of the following:

- which organisations, collectively or individually, will have 'ownership' of the initiative?
- are interfaces with services provided at other levels of the system properly defined?
- what are the service components within the initiative?

- how is the responsibility for the delivery of individual programme elements within large scale initiatives to be allocated?
- how is funding to be organised?
- how are administrative and professional resources to be allocated?
- where are administrative and professional resources to be located?
- have all NHSScotland and Local Government statutory and voluntary support commitments been identified, and have these agencies 'signed up' to the extent of those commitments and the way in which they will be deployed?
- if private sector participants are involved in the delivery of individual programme elements, how are those elements to be secured, maintained and monitored?
- if the voluntary sector is to be involved, how is that involvement to be enlisted and sustained, and what administrative/professional underpinning may it require from NHSScotland/Local Government?

Resource implications

3.20 A major benefit of delivering CHD services in the primary care and community sectors, where this is appropriate, lies in the very high level of health gain that is achieved for relatively low cost by comparison with available alternatives. Clearly, it cannot be assumed that required standards can be met without some additional investment in buildings, staff and/or management resources. In some cases, that investment may need to be substantial.

3.21 It is likely that in the majority of cases the resources that will be needed to deliver the required standards in the primary care and community sectors will come from:

- funding for new or re-structured services by:
  - (i) direct grants from the Scottish Executive or other funding authorities, including lottery funding;
  - (ii) reallocation of priorities within existing NHSScotland or Local Government budgets;
  - (iii) redeployment of efficiency savings from NHSScotland or Local Government operations to support new or expanded initiatives;
  - (iv) reinvestment of 'one-off' gains from sale or decommissioning of land or buildings;
  - (v) private finance and other public/private sector initiatives; and
  - (vi) charitable donations, including contribution of goods or services from the voluntary sector;
- redeployment and/or expansion of existing staff and administrative premises within existing operational structures;

- investment in training and development of new and/or existing staff;
- rationalisation of existing estate services and facilities to serve local communities where this can be done appropriately;
- construction of new buildings in suitable locations to serve local communities where no suitable and appropriately located facilities exist or the existing cannot meet the needs of modern cardiac care;
- use of information technology, including telemedicine, to reduce the number of sites from which referral services are provided, and to increase the scope and quality of services provided by GPs and other primary care and community professionals.

Special needs of adolescents and young adults

3.22 In considering how the role of primary care and community services may need to be adapted to the needs of children, it is important to make the distinction between services that are directed towards the expectant mother and unborn child, neonates and infant sufferers from heart diseases, a number of whom will already have undergone clinical intervention, and those which are more appropriately directed towards adolescents and young adults who may have progressed following cardiac interventions as neonates or in early childhood.

3.23 Many of those services will already have been established, or will be in the process of being established, to meet the needs of the adult population. Some may have to adapt to the rather different focus that is required when providing for the needs of children and their family and/or carers. They may need to:

- concentrate on the health of the mother as well as that of the unborn child during pregnancy;
- monitor the progress of patients following pre-natal and childhood cardiac conditions as they mature into adults;
- ensure that any necessary continuity of clinical or other involvement, once that stage has been reached, is in place.

Of particular importance will be the support given to relatives and carers. In the case of children with multiple disabilities requiring some form of residential care outside the home, appropriate placement within the community. It should be noted however that in contrast to adults, children who have recovered through appropriate treatment of cardiac conditions identified prior to or at birth may not require extended after care or rehabilitation, except where other non-cardiac conditions are present. Detailed information on this topic will appear in SHPN 28: 'Facilities for cardiac services Part 2', to be published later.

Future developments and their impact on service delivery

An integrated service in primary care and community settings

3.24 While it is not the purpose of this document to predict the future, the increasing use of scenario techniques in the planning of health and related services suggests that a brief review of likely developments in the further integration of care in the primary care and community services over the next ten years is of interest to development and planning teams.

3.25 NHSScotland action plans already take into account many of the factors that are driving change in health related services provided at the primary care and community levels and many of these factors are technology based.

Integrated planning for healthcare

3.26 There have been substantial advances in the integration of:

- health and social care;
- housing;
- employment;
- public transport;
- recreation/leisure;
- education.

3.27 Voluntary organisations, users, carers and other interested parties and community organisations will become much more involved in all planning processes at the PCT/local authority and 'district wide' levels.

3.28 Planning processes may become more flexible, allowing organisational coalitions to form and dissolve across boundaries as may be necessary to deal with local issues.

Patients control their own care

3.29 Many more people, when they suffer a symptom, may consult an interactive website; interactive data from that system could be captured and routed to local care centres for review, analysis and follow up where necessary.

Access to services

3.30 NHS 24 is a new initiative intended to provide an innovative route for service access by telephone or the Internet. This is valued as part of a service access implementation plan. Such plans also include the primary and higher level service provision described elsewhere. The importance of CCU and A&E service access is particularly emphasised.

GP services

3.31 GPs working within multi-professional primary care teams will actively develop their capacity for resolving problems and substituting for secondary care; new organisational structures will evolve that will shift the role of the GP from that of gatekeeper to secondary care to that of leader and co-ordinator of care.

Healthcare in the community

3.32 Local communities may increasingly be served by 24-hour local care centres offering all routine and non-specialist urgent care, including social care. Patients would continue to have their own personal doctor, but they would be supported by other services, including out-of-hours GP services, nurse-led care and nurse prescribing.

3.33 Principles of clinical management are being implemented in non-hospital settings; complex care will be devolved to multi-professional teams with decision making responsibilities; and many GPs and other community based doctors and nurses will develop 'special interests' in particular client groups or major conditions, such as cardiology.

3.34 Patients with specific and/or long term needs will be referred to multi-professional teams providing integrated care for different client groups, including minor injuries services, home and day care and access to local rehabilitation and respite care services.

3.35 Healthy living centres will offer health promotional advice and a full range of information services and deliver outreach support to deprived neighbourhoods and advocacy services for all members of society.

3.36 Linked closely with local care services, ambulance paramedic staff now have the skills and equipment to support home visits to patients with chest pain as an urgent service. They are able to provide optimal care at the scene of the traumatic cardiological event and during transport of the patient to hospital, or alternatively transfer care to a GP or nurse specialist based in the local care centre. The use of telemedicine for ECG communication is slowly developing in the UK and will have particular relevance for A&E departments.

3.37 There will be increased numbers of people in every community, and particularly in shopping malls, community centres, etc, who are trained to act in the case of a cardiac emergency as 'first responders'. They will have access to appropriate personnel and life saving equipment. Defibrillation and basic life support equipment provided in tamper proof, but accessible, orange cabinets with a blue light hooked up to a central control. Published guidance is available from the Resuscitation Council. For new sites, HSE input can be particularly important.

Impact of technology

3.38 Future use of telemedicine, or telecare, may allow many diagnostic and assessment services to be accessible locally, with expert consultation available

from specialists based in acute hospitals through telelinks. Ambulance paramedics will be able to access the same services. This is part of the overall push towards the electronic patient record (EPR).

3.39 Increased use of computers is planned to make electronic transfer of information across system boundaries a routine procedure. GPs will be able to access information on-screen during the course of a patient consultation and discuss outcomes and options for particular conditions directly with patients and carers, etc.

3.40 Electronic patient records are intended to make relevant information quickly accessible to all professionals involved in each patient's care.

Impact on service delivery

3.41 Changes in the organisation and management of care will mean that GPs and other health professionals can, to a greater degree, manage the needs of patients within the local care centre, and its associated network of services, rather than admit to hospital.

3.42 Numbers of patients attending acute hospital A&E departments may fall as lesser general needs are met by primary care and local care centres. However, acutely ill cardiac patients will continue to require both urgent A&E and CCU access.

3.43 Shift of emphasis and professional and technical support for community-based services, including increased use of telemedicine or telecare, may reduce numbers of referrals to acute hospital outpatient departments (OPDs) and admissions to acute hospital beds. Patient journeys to hospital will be reduced, and improved access to services provided. However, critical dependence on high-level services for many cardiac patients is expected to continue.

3.44 The number of referrals to hospital OPDs may decrease because of the development of local care centres and the impact of telemedicine. The proportion of the hospital's work that is managed on an outpatient basis will increase as many more procedures will be managed as outpatient procedures.

Services and facilities to be provided in support of primary and community based care

3.45 This Section explores in detail the physical and environmental implications that the delivery of services, at the primary care and community levels, have for the health estate. It also looks at other formal and informal settings in which cardiac-related services are delivered. For the purposes of this document, these settings are grouped under three headings: general practice premises, the patient's home and the community.

Services and facilities in general practice premises

Services

3.46 The range of services that are provided by general practice premises, and the professional and support staff who are responsible for that provision include:

- patient reception, documentation and waiting, booking and re-booking of appointments, prescription renewals, etc. These activities, and those associated with the running of the practice, would in larger practices be under the administrative control of a practice manager;
- booked or emergency consultation with a GP or practice nurse, possibly involving couch examination and/or minor procedure. A majority of the currently non-acute cases requiring further expert diagnosis by a cardiologist will be identified in this setting in the first instance. In the case of patients suffering from a post-acute episode or those being monitored for chronic conditions, including chronic heart conditions, this may involve:
  - (i) a review of recent contacts with acute services;
  - (ii) monitoring and where necessary modification of medication;
  - (iii) monitoring of blood pressure, blood sugars, etc;
  - (iv) advice or assistance in achieving and maintaining necessary lifestyle changes, including cessation of smoking.
- emergency or routine home visits, including home visits by a member of the primary care team;
- booked appointments with a practice nurse for minor investigations and procedures including specimen collecting, blood pressure, etc.;
- maternity, fertility and well woman's clinics, usually conducted by a nurse practitioner or practice nurse or attached midwife;
- raised blood pressure and other cardiovascular irregularities are significant complications of pregnancy. These may be diagnosed for the first time during routine testing and examination of women who do not otherwise attend their GP on a regular basis. In addition, concerns about the cardiovascular health of the foetus that might lead to problems in the antenatal period, at delivery or in later life, may surface at this time. These will require referral to a paediatric cardiologist or specialist in foetal medicine and subsequent monitoring by the GP;
- counselling services, which can generally be divided into two main types:
  - (i) those who have to come to terms with disturbing news or with bereavement will often benefit from informal counselling by someone in the practice who has a personal knowledge of the person and the circumstances – for example, the patient or relative's own GP, nurse practitioner or practice nurse. Where significant mental stress or disturbance is involved, a community psychiatric nurse (CPN), if available, might also be involved, and in those circumstances it may be necessary to refer the sufferer to a specialist;

(ii) some practices are able to offer advice on Local Authority services, benefits, voluntary organisations, etc. that may be available to patients and/or carers depending upon their circumstances.

- other services that are often provided from GP premises, and which can be of benefit to cardiac patients include physiotherapy, health promotion, keep-fit and advice on dietary matters.

Service providers

3.47 An LHCC/PCT, involving general practice, providing all of the services listed above would, in addition to the principals, employ quite a number of staff. In the context of managing, developing and marketing its services it would operate like any other small to medium-sized enterprise.

3.48 Clinical service providers include:

- Full-time:
  (i) one or more GPs, one or more of whom in a large practice might specialise in a particular field in general practice, for example, paediatrics;
  (ii) a nurse practitioner;
  (iii) a practice nurse.
- Part-time:
  (i) an attached midwife;
  (ii) an attached physiotherapist;
  (iii) an attached health visitor;
  (iv) an attached CPN;
  (v) an attached counsellor.
- Support staff:
  (i) a practice manager;
  (ii) a receptionist;
  (iii) clerical staff.

3.49 Contracted-out services may include:

- cleaning;
- specialist equipment maintenance, calibration and certification;
- clinical waste disposal;
- medical device and instrument decontamination.

Service development

3.50 Some general practices now offer more specialised services that are directed specifically towards the cardiac patient and are increasingly likely to do so in the future. They are designed to take advantage of the broadly based skills that are available in general practice, and of technical developments that have made it possible to develop or locate some diagnostic and treatment services in primary care that were previously only available within the acute hospital.

3.51 Successful improvement implies greater and better use of information as a means of ensuring consistency of approach and outcome in the treatment and management of individual patients. Specifically this requires that:

- every practice should have a systematically developed and maintained practice based CHD register in place that is actively used to provide structured care to people with CHD;
- every practice should have a protocol describing the systematic treatment and follow up of people with CHD agreed locally and being used to provide structured care to people with CHD;
- every practice should have clinical audit data not more than 12 months old recording the interventions carried out for people with diagnosed CHD.

3.52 The development of special 'practice cardiac prevention clinics', typically nurse run and doctor supported, to which patients with CHD and/or at high risk of a cardiac event are invited from within a practice. These clinics structure care by the active use of paper or electronic practice protocol/guidelines and/or patient records. In some cases, a number of practices might combine in providing this service in order to share scarce resources, such as cardiac nursing skills.

3.53 In Scotland, relatively few practices are fully equipped for ECG recording and defibrillation. Although it may be possible to provide the equipment, the main problem relates to the training and experience of the individuals concerned. Many Health Centres may presently not wish to have this facility available. It does however have implications for remote areas. Examples of equipment based services include:

- defibrillation: people with symptoms of a possible heart attack should receive help from an individual equipped with, and properly trained in the use of, a defibrillator within eight minutes of calling for help . In many cases, it will be the GP or other member of staff who will be required to meet that standard in patients presenting at the clinic with chest pain or other symptoms;
- electrocardiography (ECG): the availability of 12-lead ECG facilities in some practices is an example of the increasing availability of reliable, portable and easy to use diagnostic equipment to practitioners in the primary care sector. Telemedical communication with a CCU is of value here.

Facilities

3.54 In LHCC/PCT practices that already provide a broadly based service supported by non GP but otherwise professionally qualified staff, the physical resources that will need to be available in premises in which cardiology is being developed as a GP specialty will not differ greatly from those required to handle any other group of patients. Despite the rapid and continuous broadening of the skill base of GPs that has occurred in recent years, and changes in perception of the GP's role in the delivery of healthcare, general practice remains the principal focus for 'people oriented' care within NHSScotland. The technologies that are being introduced into general practice to support it in that role, and make it more effective, are in the main highly portable.

3.55 GP facilities are already well described in a number of documents, including new primary care guidance to be issued in the near future. The aspects of provision that might be of particular relevance to the cardiac patient are:

- location;
- car parking and access;
- reception facilities, including facilities for holding patient records;
- emergency equipment/procedures;
- consulting/examination rooms, including facilities for practice nurse and attached specialists;
- minor treatment facilities;
- counselling;
- equipment storage;
- facilities for telemedicine;
- information technology/EPR; and
- record keeping.

Services and facilities in the patient's home

3.56 The majority of people who have experienced a cardiac episode and who have progressed beyond the acute and/or interventional stage are able to return to their own homes and lead relatively full and active lives within the community. They require little support other than normal GP services and encouragement to maintain necessary lifestyle modifications. Others, predominately the more frail and elderly, or those suffering more serious long term or chronic conditions, may need to be accommodated in sheltered housing or in nursing or residential care homes. These, together with others in the same category who are still able to live in their own homes, may need to receive additional support from health or social services. Much of this can, and desirably should, be provided within that residential setting. In both groups there will be some who:

- suffer collateral or coincidental physical disability or sensory deprivation;

- have learning difficulties;
- exhibit anti-social behaviour;
- exhibit some combination of all three.

This part of the guidance is principally concerned with the provision to be made for these people.

Services

3.57 The services that may need to be provided on a permanent or temporary basis to people with chronic or post-interventional heart conditions in their own home will not differ in general terms to the services that would be provided to any other group with similar support requirements presenting in any other clinical specialty except for the special need to control the risk of recurrence. These may be summarised as:

- domiciliary visits by GP and/or practice and/or district nurse, physiotherapists, etc.;
- telephone access to NHS 24 and/or ambulance services in case of emergency;
- home help, meals on wheels and other community based domiciliary services;
- counselling, advice and/or assistance in adapting to changes in lifestyle and economic circumstances, including advice on entitlements, refurbishment grants etc.; and
- support for carers, including access to respite care services.

Service providers

3.58 These are:

- LHCC/PCT services including GPs and other professionals providing services in the primary care sector;
- local authority and district nursing services;
- community groups and charitable/voluntary sector organisations.

Facilities

3.59 For the majority of people with diagnosed and/or post-treatment ongoing heart conditions living in their own homes, the normal home environment will provide a perfectly adequate setting for any further interventions or services that are likely to be delivered there. However, new developments in 'at home' monitoring are noted. These use measurement and communication devices within the home to continuously survey the domestic, and to some limited degree clinical, condition of the patient. In accordance with protocols, it can be assumed that patients who have been hospitalised and/or who have received

treatment following a cardiac event will have been assessed in relation to their ability to cope with activities of daily living prior to discharge. Necessary consultation will have taken place between health and local authorities and/or carers on the support to be provided in the home to patients and the necessary infrastructure will be in place. For a small number of patients however, it will be necessary to modify the home environment if care in the home is to be a realistic option.

3.60 Examples of such modifications include:

- provision of designated disabled car parking close to the residence and barrier free external access arrangements;
- internal reorganisation to allow ground floor living, with the possible necessity to provide additional WC and bathroom facilities;
- adaptation of existing spaces to allow convenient access by wheelchair, including adaptation of WC and bathroom facilities;
- provision of additional storage facilities for equipment and for the secure storage of prescribed pharmaceuticals;
- ensuring that there is space and appropriate arrangements for administration of oxygen therapy and for defibrillation;
- exceptionally the installation of at home monitoring equipment and telemedical communications where justified.

3.61 It will be appreciated from the above that there is no real distinction to be made in the accommodation requirements of severely dependent patients with cardiac disease living at home and any other group of highly dependent and/or disabled people. Substantial additional guidance on the design of such facilities is to be found in the publications of, for example, the Disabled Living Foundation www.dlf.org.uk and in the documentation supporting the physical provision requirements of some disability legislation and Codes of Practice.

4. Primary and secondary services interface

Introduction

4.1 In this Section, interfaces between primary care, including community-based, services and services provided at the secondary level of care are explored under five headings:

- services provided at the primary care level;
- patient referral routes;
- telemedicine and teleradiology;
- ambulance services; and,
- services provided at the secondary level.

4.2 For the purposes of this piece of guidance, only those service provisions at the primary care level that form an active part of the interface are described here; the same is the case for services at the secondary level. For more detailed descriptions of the services provided at the primary care and community levels see Section 3, and for similar information about services provided at the secondary level see Section 5.

Services provided at the primary care level

4.3 The services provided at the primary care level forming part of the primary/secondary interface include:

- LHCC/PCT general practice clinics, including those with some capacity to undertake limited work-up of suspected cardiac emergencies or conditions. Also included under this heading are GPs undertaking domiciliary visits to patients' homes, including residential care homes and similar institutions and such facilities located in the private sector;
- NHS 24;
- ambulance emergency services, with and without telemedicine links.

Patient referral routes

4.4 Patients who are at risk of, or who have been diagnosed as having CHD, will require access to consultative, diagnostic and treatment services located at the secondary level of care, district general hospitals (DGHs) or, where conveniently available, rapid access chest pain clinics, as emergencies, outpatients, day patients or inpatients. Much of the service will relate to short or

medium term admission to a CCU if acute symptoms develop. This access can be achieved in a number of ways, as outlined below.

GP referral to a specialist

4.5 Following attendance at a GP clinic, a patient may be referred to a cardiologist for consultation and confirmatory diagnosis using largely non-invasive diagnostic techniques. In some cases, some of the diagnostic work may have already been undertaken in the GP clinic.

GP referral direct to hospital

4.6 A patient may be referred for diagnostic examination, either as a GP open referral to hospital services, if this service is provided, or to a rapid access chest pain clinic. Arrangements between PCTs and local Acute Trusts will reflect these needs and are important when considering likely capacity requirements particularly in CCU.

NHS 24 referral

4.7 A patient may in the future be referred from NHS 24 or a NHS walk-in centre to a GP or hospital A&E or CCU for further investigation.

By ambulance as an emergency

4.8 The patient may be brought to hospital by ambulance as an emergency from home, the GP clinic or other location following a call to an ambulance service by the patient, GP or NHS 24, or by another person. If the hospital designated for the reception of suspected or confirmed cardiac emergencies has a CCU, this unit will by preference receive the patient on arrival, otherwise he or she will be received in the main A&E department before transfer to the intensive care unit, theatre or cardiac ward. Increasingly, patients brought to hospital by ambulance as emergencies will already have been given an ECG, together with cardio-pulmonary resuscitation and defibrillation in the event of cardiac arrest, high concentration oxygen, pain relief and aspirin. Upon arrival, patients with suspected or confirmed AMI will receive thrombolytic, ‘clot-busting’, therapy without further delay. If AMI is not confirmed before arrival it will be necessary to do this, usually by ECG, before administering thrombolysis, since the presence of thrombolytic drugs can cause complications in patients found to be suffering from a non-cardiac-related condition involving internal bleeding.

Self referral

4.9 A patient may refer him or herself, usually to the A&E department of a hospital or to a rapid access chest pain clinic. Procedures in the case of self-referral will centre on initial triage usually by the Manchester system.

Telemedicine

Key communication functions

4.10 Telemedicine is a firmly established avenue within the UK for the improvement of services across many aspects of cardiac care. An agreed data set for patient care and record keeping is in the process of definition by a team within the cancer policy development domain.

4.11 Strong communications between the professionals involved in the care of cardiac patients is vitally important. Hospital based professionals have a specific duty to inform GPs as to the condition of their patients, particularly at or following discharge back into the community. Telemedicine may be used for this key aim, as might e-mail.

4.12 Data communication to and from A&E together with CCU services and between those departments and ambulance/paramedic services is subject to rapid development at this time. The following areas of application have been reported extensively during enquiries made throughout the UK to support the writing of this document:

- the advantage of and clearly emerging need for ECG monitoring by ambulance/paramedics/community healthcare services combined with telemedical communication of the data to A&E departments or the CCU is thought to generate clear clinical benefits, particularly in terms of early triage. This is seen as important in determining whether or not the patient should be taken to hospital, and if so whether thrombolytic drugs will be required urgently;
- communication of background medical information initially between the A&E department and GP then subsequently to other involved hospital departments is a recognised information flow. For patients taken to A&E or to a CCU with chest pain, an outline of their medical history, particularly any indications of latent cardiac disorder, can be of particular assistance;
- many A&E departments are equipped with information technology systems specific to their needs. The linkage of these A&E-specific systems to general patient administration systems and the CCU is seen as beneficial to patient care. In particular, there is a need, within A&E to trace or generate hospital numbers for use on tracking and schedule devices or cards;
- the ability to transmit results from ECG monitoring by local area network (LAN) or wide area network (WAN) to a cardiologist is extremely valuable in the initial diagnosis of CHD. Commonly, A&E ECG systems are networked to CCU and cardiac angiography facilities within the same hospital or elsewhere;
- pathology services are extensively used by the CCU in the care of cardiac patients. Accordingly, reliable and rapid access to pathology is of value. The use of an air tube system for the conveyance of samples may be beneficial.

Record keeping requirements

4.13 Particular emphasis must be placed on the importance of accurate and reliable record keeping. Every practice caring for cardiac patients should hold records and hospital correspondence in a way that permits ready retrieval and relates those records to the appropriate date order. There is also a strict requirement that a clear and reliable drug therapy list, particularly for patients on long-term therapy, be identifiable.

4.14 The concept of the CHD register, particularly with reference to the use of aspirin, is a part of the fair access and effective delivery component. Again, this has implications for practice and provision of facilities in both A&E and the CCU. This requires that the records acquired or amended within that department be integrated with appropriate records contained elsewhere, both within that establishment and in others concerned with the patient's care.

4.15 In the longer term, it is anticipated that data will be held in an electronic patient record (EPR) and that clinical codes will be used. Appropriate structures are in development for such records, including those parts that relate to chest pain and cardiac disorder. These data are expected to evolve toward a form in which its use for the NHS may be applied in a reasonably direct way.

4.16 In summary, the EPR will, therefore, be expected to be the principal source of detailed clinical information and can, as such, be used to monitor how well services are delivered. Secure telemedical communication of this record is a growing component of integrated cardiac care across the levels of service and individual care providers.

Infrastructure and built environment implications

4.17 The move from communication by film and paper records into a digital data based information environment in cardiac services has important implications for operational requirements and building design. Team working may become based partly on this form of communication, reducing face to face meetings and case conferences and allowing more rapid working with better availability of the appropriate professionals.

4.18 Within NHSScotland, the record keeping process has largely been dealt with on film, videotape and paper, since such methodologies are established and large areas have been set aside for storage purposes. In new and reconfigured cardiac facilities, maintaining so complex a record on hard file materials is no longer viable. A move away from paper and hardcopy materials is appropriate from an economic and operational viewpoint.

4.19 In light of the above, the use of comprehensive computerisation at new and reconfigured departments is a strong option and in keeping with a trend in the UK. Accordingly, a robust computer LAN architecture connecting multiple servers and computer workstations is needed, and this should be reflected in the design. Suitable rooms should be allocated in which these servers and the associated network hub units can be placed. It may be possible to dispense

with allocating large areas of space to store videotapes, hardcopy films and paper generated from the patient's treatment. Space should be allocated, however, for additional workstations with single and double large monitors for cardiac image review from network sources or CD-ROMs. Care over lighting conditions and monitor placement will be important.

4.20 It is important that data is secure, not only against intrusion, but also against loss. Interruptions in the ability to transmit data from places of storage to places of use may be detrimental to patient care outcome. Accordingly, if a digital option is to be pursued, the backbone network will require some route and hub duplication, together with dual connection of servers and other devices.

4.21 The multi-disciplinary nature of the work requires that many of the services presently offered by the hospital remain distinct, but that they become intimately associated, where necessary, through the sharing of digital information. This being the case, the cardiac network used must have close ties to any network within the hospital itself or simply be a part of that greater whole. Furthermore, if the hospital network is of relatively modest bandwidth, some upgrades may be necessary.

4.22 The geographical extension of the information base to other service providers, particularly at primary care level, requires the provision of a secure and robust WAN. It is likely that appropriate ISDN and DSL alternatives may also be required. A summary of a treatment scheme on a given patient, backed by example images, may be prepared and made available on a server that is externally addressable. This so called 'external server' may be on the outside of a 'firewall' that will protect the remainder of the system against computer hacking from outside and will contain its own very robust security features.

Ambulance services

4.23 Ambulance services form a vital part of the primary/secondary interface, and in many cases form the effective link between these levels.

4.24 The pre-hospital interventions that patients with AMI should usually receive, unless contra-indicated, are:

- cardio-pulmonary resuscitation in the event of cardiac arrest;
- high concentration oxygen;
- pain relief (e.g. 2.5 to 5mg diamorphine i.v., 5 to 10mg morphine i.v. with anti-emetic);
- aspirin (at least 300mg orally);
- immediate transfer to hospital.

4.25 The ambulance service, the hospital service and primary care teams should plan their services together and put in place systems of care in which:

NHS 24

- provides immediate advice to people calling about suspected heart attacks and arranges for the ambulance service to send appropriately trained and equipped help immediately.

Primary care teams

- call '999' for an ambulance before attending when someone calls with symptoms suggestive of heart attack.

Ambulance services

- provide immediate advice to people calling with symptoms of suspected heart attack;
- maintain telephone contact with the caller, providing advice on cardio-pulmonary resuscitation in the event of cardiac arrest until properly trained and equipped help arrives;
- despatch ambulances using a uniform call prioritisation system;
- get an individual trained in the use of and equipped with a defibrillator to people with suspected heart attack within 8 minutes of the call for help;
- ensure that ambulance paramedics and technicians provide and record the delivery of appropriate pre-hospital treatment to people with suspected heart attacks and transfer people with suspected heart attack to hospital in less than 30 minutes from the call;
- ensure that a defibrillator and someone trained in its use remain at the patient's side for the whole of the journey from the initial response to the handover in hospital.

Services provided at the secondary level

4.26 The role of a secondary centre is the diagnosis of CHD and other cardiac conditions and appropriate management using primary non-invasive therapy. In addition, most referrals to tertiary centres are made by specialist general physicians and cardiologists working in secondary centres. Patients who are referred, or who are self referring, from the primary sector, including those referred as emergencies, will need to have access to the following diagnostic services (see also Section 5):

- resting, stress and ambulatory ECG;
- echocardiography;
- radio-nuclide imaging (nuclear medicine);
- chest X-ray.

4.27 These patients will also need to have access to the following treatment services:

- thrombolysis and other parenterally administered drugs; and
- temporary cardiac pacing.

5. Cardiology services at the secondary level

The coronary heart disease service at the secondary level

5.1 This Section describes the role of the secondary sector in the provision of cardiology services in general. In terms of cardiac centre classifications for estates purposes, this Section covers 'minor cardiac centres'. It describes the services delivered at this level and the manner of their delivery, and sets out the planning and physical resource implications that these service delivery arrangements have for NHSScotland. It should be noted in this context that many hospitals offering tertiary level cardiology, classified for estates purposes as 'major cardiac centres', including those located in single specialty hospitals, provide a secondary level service to geographically defined local catchment populations. The requirements for these centres, which differ substantially from those covered in this Section, are discussed in Section 6.

5.2 In this SHPN it is assumed that all secondary level 'minor cardiac' services are hospital based, and closely approximate to the services that are delivered in a district general hospital (DGH). Where appropriate, references will be made to services provided in other locations, for example, outreach services in primary care settings. More detailed descriptions of those services or the facilities that are required to support them are provided elsewhere, under the appropriate Section headings.

5.3 Medical cardiology services only are offered at the secondary, or 'minor', level. Cardiac and cardiothoracic services and other highly invasive measures remain wholly focused in tertiary and super specialty centres. The functional and physical relationships that must be achieved in planning centres at the secondary level are restricted to those required to support cardiology services only. These are therefore fewer in number, different in their priority ordering, and rather less complex than those required to support the integrated cardiology/cardiac/cardiothoracic and surgery programmes located at the tertiary, or 'major' level.

5.4 As well as the broad range of non-invasive investigations that form the substantial part of a secondary centre's workload, investigative angiography is now commonly regarded as a safe and appropriate procedure to be undertaken at the secondary level. Cardiologists working in secondary centres in the UK are increasingly capable of undertaking a broad range of minimally invasive imaging supported investigations and procedures, for example, percutaneous transluminal coronary angioplasty (PTCA), that currently form a large part of the workload of the tertiary or major centre and which in NHSScotland are currently undertaken exclusively in that setting. Time limits for the provision of emergency surgical support exist for PTCA and similar procedures. Risk factor considerations will always be applied when patients are considered for PTCA, but particular care will be taken at minor centre level, and transfer to a major surgical centre will take place if necessary (see paragraph 2.21).

5.5 PTCA should be performed only with pre-arranged surgical cover and in institutions where emergency cardio-pulmonary bypass can be established within 90 minutes of the decision to refer the patient for emergency CAGB. If emergency inter hospital transfer is required, the journey time between hospitals should not exceed 30 minutes. There will be many DGHs that will be unable to meet that criterion.

5.6 It will be seen from the above that the trained operators, surgical services and other resources that must be on site or readily available to support such work are not always available in most DGHs at the present time and would need to be provided before the programme can be implemented locally. It is also the case that the very rapid growth of cardiology in the secondary sector means that even some recently constructed centres may not always provide the level of support, in terms of the available facilities and the arrangements that are now required to deliver standards at this level. Making good these basic deficiencies is likely to remain a high priority for investment in estate development until the shortfall has been met, and creates an important challenge for the estates community.

5.7 For all these reasons, it is likely that further devolution of services from the tertiary to the secondary sector will only be achieved over time, and may involve a number of interim arrangements. Such arrangements will include Trusts combining to exploit 'networked' access to existing or newly created fixed resources on a rotational basis. Others might involve the deliberate development of purchasing policies for new angiography equipment, of the kind under development or coming onto the market, that optimises benefit to a number of clinical users and reduces the cost of specialty-specific provision.

Role of the secondary level

5.8 Delivery of an expanded hospital based service to defined local catchment populations on a referral or emergency basis is not however the only way in which a secondary centre can contribute to the delivery of standards. It also has a crucially important role to play in the delivery of the broader context of standards for the reshaping of the service as a whole. This is done in a number of ways.

5.9 As the focal point in the nexus of hospital, primary care and community-based services, the secondary centre has substantial relevant expertise and a significant role in determining how those services can best be organised and delivered to meet locally defined need through optimal use of locally available human, institutional and physical resources.

5.10 Agencies with which a secondary centre will be involved in fulfilling this role include:

- general practices and NHS 24;
- primary care Trusts;
- community hospital Trusts (where these exist);
- NHS ambulance, Trusts and hospital car services;
- Local Authority community-based nursing and therapy services;
- service providers in the private sector;
- voluntary and charitable organisations.

5.11 Formal planning structures for CHD services should be locally based and locally driven, and the role of the clinical specialist is to support rather than to lead these local initiatives. Inevitably, it will be the case that in many areas of prime concern the clinical and nursing team based in the DGH will be the principal or indeed only source of relevant knowledge based input into the process. It is important that whatever structures are developed locally should contain clear pathways for these inputs. This will ensure that the resultant plan is both comprehensive and fully subscribed to by the agencies involved.

5.12 Currently, most referrals to tertiary centres, and therefore a significant part of the tertiary level workload, come from cardiologists and general consultants working in DGHs. Whilst this will remain true, a number of recent and planned initiatives are likely to impact upon the level of such referrals in the future.

5.13 The incidence of, and mortality arising from, CHD has been decreasing significantly over the past 20 years, but not uniformly. Current projections for the Scottish population as a whole are that it will remain relatively static to the year 2001, at about 5.1 million, and decrease slowly thereafter. Within that population, the numbers and proportion of older people, currently about 1 in 5, has been rising and is projected to rise at an accelerating rate. Current mortality rates for CHD in the population aged 65 years and under are about 220 per 100,000 and for those aged 65–75 years are about 1,085 per 100,000. Real numbers of referrals are not likely therefore to reduce uniformly within the age spread of the population as a whole, and some types of referrals may actually be expected to increase over the short to medium term.

5.14 The emphasis that is now placed on early diagnosis and treatment is likely to result in the identification of a substantial hidden and previously unmet need for the treatment of advanced CHD, much of it involving services and facilities only available at the tertiary level. This may cause a temporary but significant ‘bulge’ in the numbers of patients being referred from the secondary level to such services and facilities and should be considered in the process of sizing units.

5.15 The success of early diagnosis and treatment programmes, and in particular the success of many modern interventional techniques undertaken at the tertiary

level will mean an increasing 'pool' of patients who may require further treatment of residual conditions or develop other heart related conditions in later life requiring access to tertiary services and facilities.

5.16 Notwithstanding all of the above, it is likely that in the future there will be a significant increase in the number of patients retained within the secondary level and receiving all their diagnostic and non-interventional treatment and care in that location.

5.17 To ensure that patients with diagnosed CHD, and those recovering from AMI or other cardiac emergency, receive appropriate and systematic advice the treatment and follow up, should consider the benefits of revascularisation and the offer of rehabilitation and secondary prevention. This places the secondary centre in a pivotal role between the specialist services only available at the tertiary level and those provided in the primary care and community sector.

Access to secondary services

5.18 Patients requiring access to cardiology services at the secondary level will normally progress as:

- ordinary referrals to cardiology outpatient/chest pain clinics from their GP, NHS 24, practice or multi-practice or primary care group (PCG)/PCT cardiac prevention clinics;
- referrals to GP open access diagnostic services;
- cross referrals from other clinical specialities within the hospital; or
- emergencies, and self referrals to the hospital's Accident and Emergency (A&E) department or CCU, usually following AMI or a suspected case of AMI.

5.19 It should be noted in this context that the GP clinics and other patient access facilities in the primary sector, as well as all emergency services vehicles, have the equipment and skilled staff available to undertake emergency cardio-pulmonary resuscitation (CPR) and defibrillation.

Accident and emergency services

5.20 The majority of ambulatory A&E patients who will subsequently be investigated for CHD or other cardiac disorders will present with chest pain, as will those taken to A&E by ambulance or the paramedic services. In the latter case, some advance ECG and general information to confirm or deny the presence of a heart attack may be available. Currently, only 1 in 20 patients attending A&E with chest pain is subsequently diagnosed as suffering from CHD or other heart disorders.

5.21 The admission of suspected heart attack cases direct to the CCU, where available, is seen as the preferred route. The approach will be influenced by

any advanced information received from primary or paramedic services. Failing this, A&E triage will generally be the method of choice.

5.22 There is a special duty on A&E departments to attend urgently to patients complaining of chest pain. A&E is seen as the preferred point for immediate care if no CCU bed can be made available following triage. The A&E teams are seen as providing an immediate assessment of the patient's condition and then proceeding, if appropriate, to provide thrombolytic or clot lysis drugs with the minimum of delay.

5.23 People thought to be suffering from a heart attack should be assessed professionally and, if indicated, receive aspirin. Thrombolysis should be given within 60 minutes of calling for professional help and this is clearly a target that will be seen by A&E departments as relevant to their practice. NHSScotland Trusts should put in place agreed protocols and systems of care such that persons admitted to hospital with proven heart attacks are appropriately assessed and offered treatments of proven clinical value. Clearly A&E will be a key step in this pathway to appropriate intervention.

Essential basic principles of A&E service provision

5.24 A&E is charged with the duty to receive patients suffering from chest pain and then to move forward into making a professional assessment of their condition, followed by the administration of thrombolytic drugs if CHD is suspected. The service provision must clearly reflect these basic aims together with the possibility of clinical complications, such as the patient also suffering from diabetes.

5.25 There will be a need for triage facilities for ambulatory patients. These should be such as to support quick assessment, including the proper identification of those with chest pain and the conduct of ECG examinations within the triage area or by transfer to a resuscitation bay equipped with ECG monitoring and resuscitation equipment. For larger A&E units, a dedicated cardiac triage bay will be required, although this need is influenced by CCU capacity and availability.

5.26 The majority of centres will apply the Manchester system for triage and this will imply the allocation of green, yellow or red code colours that are, in part, dependent upon the severity of the patient's symptoms but also relate to the perceived short-term prognosis and associated risk factors.

5.27 The patient journey is dealt with in detail below, but there will be an essential need to retain some patients for observation in appropriate facilities, most commonly in the CCU or a unit associated with A&E.

5.28 Although less common, congestive heart failure, valve disease and cardiac infection are recognised cardiac diseases and A&E departments will require facilities such as to permit the initial assessment and appropriate referral of patients in these categories.

5.29 There is the possibility that paediatric cardiac sufferers will be taken to A&E in some circumstances, although more commonly this patient group will be in the care of specialist children's services and will attend those facilities as appropriate. Many A&E departments do contain a paediatric bay clearly equipped with facilities suitable for use with children. Although these will not be specific to cardiology as distinct from the broad range of paediatric disorder or injury, they will always contain equipment for cardiac monitoring.

Professional team and support requirements

5.30 In general terms, the clinical and nursing team involved in the care of those complaining of chest pain and/or subsequently confirmed to be suffering from cardiac disorder will not differ greatly from those concerned with the care of patients in other categories. In larger departments, defined as those seeing more than 30,000 patients per annum, it is likely that dedicated chest pain triage will be greatly advantageous, and additional accommodation for a triage nurse operating this service will be needed accordingly. The dedicated triage area might be expected to contain full ECG, blood pressure and oxymeter diagnostic equipment as well as general resuscitation facilities.

Resuscitation Bay

5.31 The A&E team potentially available to deal with the patient with suspected cardiac disease will include an emergency medicine or A&E consultant supported by registrars and house staff within a teaching centre. Nursing staff dedicated to appropriate areas of the department will require accommodation, as detailed in later Sections. In addition to the A&E based team, all centres with a CCU will also provide an on call cardiologist who may be expected to visit

A&E to examine patients when appropriate. A member of the CCU nursing team may also accompany the on-call cardiologist.

5.32 For congestive heart disease and other conditions in which swelling of the heart may be suspected, chest X-ray facilities will be needed and it will be necessary to accommodate a radiographer accordingly. Information within A&E departments is always much more valuable than raw diagnostic data, so that consultant opinions on X-ray examinations, pathology results and ECG tracers are preferred. With modern communications, it may not be necessary for these professionals to attend A&E, although this will vary greatly with local arrangements. See Section 4 under 'Telemedicine'.

Record-keeping facilities

5.33 Records will increasingly take multimedia form, including appropriate images, physiological recordings, pathology results and notes. Thus the facilities provided must permit secure access to this information base within the busy environment. This implies particular care in the siting of computers and display devices in patient care bays and within the office facilities. The networking strategy must be effective in ensuring rapid communication with key support departments including the CCU, radiology and pathology.

5.34 Some patients may receive short or prolonged periods of observed resuscitation. In view of the potential bereavement sensitivities and possible use of records of resuscitation in litigation, the provision of facilities for video recording of this process should be considered. Storage facilities for these tapes should also be taken into account.

Patient journey and facilities

Chest pain triage

5.35 The Patient's Charter has a requirement that patients are seen at the triage bay within 15 minutes. The sizing of the general or cardiac bay is key, with satisfactory child buggy and wheelchair access being essential requirements.

5.36 In the early stages of care for patients complaining of chest pain, the use of ECG is seen as the most essential diagnostic tool in the making of a triage decision, aside from examining the patient and conducting an interview if possible. The ECG essentially involves the detection of very small electrical signals generated within the nervous and conductive tissues associated with the heart muscle, by the attachment of up to 12 external ECG leads to the patient's chest or via the paddles of a defibrillation machine.

5.37 The ECG process is a sensitive one and requires an environment with reasonably low electronic noise levels. A stable and secure electrical power supply associated with a good quality earth, described in detail later (see Section 8), is required.

Diagnostic and patient support procedures

5.38 For patients brought to A&E by ambulance, direct transfer to a cardiac or general resuscitation bay will be appropriate. The triage procedure will be undertaken in that area. Throughout Scotland there are different triage systems with some patients bypassing A&E and being admitted directly to CCU. Other hospitals are developing A&E in such a way as to be able to give thrombolysis in the department.

5.39 For all patients, if triage by the Manchester (or equivalent) system designates them red or orange status then they are moved directly to a cardiac equipped resuscitation bay. This will contain a sophisticated ECG monitoring and alarm system. This system will require displays within the bay and at a point such as to permit observation by a cardiologist, possibly by the use of data links to the CCU and angiography. If the patient is high risk by ECG, then further diagnosis will be undertaken urgently within the resuscitation bay. This will lead to medical treatment and subsequent transfer to the CCU.

5.40 If medium risk (yellow), observation in the major treatment area will be the most common procedure of choice. This may be followed by transfer to care facilities, or discharge. Increasingly, the use of admissions wards is seen as helpful for the patient group.

5.41 Patients triaged as low risk by ECG will be registered at a reception desk and will then wait for bay availability in resuscitation. This procedure allows the team to respond should symptoms intensify.

5.42 Critically, ECG will be used to assess the immediate prognosis of the patient and to assist in deciding whether or not to administer thrombolytic drugs by the use of, most commonly, a mechanised slow-delivery syringe pump.

5.43 As well as for other patients, the A&E department will need to provide general X-ray facilities for cardiac patients. In specific connection with cardiac disorder, the possibility of a swollen heart or the presence of fluid in the chest cavity may be diagnosed by X-ray imaging means.

5.44 Some resuscitation rooms are now equipped with overhead supported X-ray tubes with remote control X-ray generators permitting safe and efficient examination of the patient while still located within the resuscitation bay. Special radiation protection precautions, described in SHPN 06: 'Facilities for Diagnostic Imaging', are needed in this instance. In addition to or as a substitute for such resuscitation-based facilities, departments will also have dedicated X-ray rooms to which the patient may be taken if his or her condition is sufficiently stable.

5.45 Increasingly, A&E consultants or cardiologists in the CCU are likely to call for ventilation and profusion lung scans for patients with chest pain or suspected CHD, in order to look for pulmonary and respiratory complications. The availability of such scanning on an emergency basis is an increasing priority. This gives rise to the need to locate nuclear medicine scanning facilities

reasonably close to A&E departments, or even for larger departments to incorporate such facilities.

5.46 Further to the above, the patient may be passed for echocardiology or immediate coronary angiography. These procedures and their facilities are described elsewhere within this document. The provision of echocardiology equipment within the A&E department is seen as unlikely to be viable on a dedicated basis.

5.47 The provision of blood gas analysis within A&E departments, partly for use with cardiac patients, is seen as essential. Simple facilities for couch side phlebotomy will always be required. The use of pneumatic tubes for communication of samples to pathology laboratories will help to speed up procedures.

Emergency resuscitation

5.48 Cardiac patients will be at particular risk of sudden instances of acute cardiac disorder, sometimes with life threatening consequences. It is essential that defibrillation equipment be readily available. Crash team access to areas where cardiac patients are located must be easy and without obstruction.

Bereavement

5.49 A small proportion of patients may die in A&E as a result of heart attacks. The need for facilities that can appropriately support relatives in observing resuscitation is growing as a result of social trends. Further, many departments will now have rooms to be used for laying out of recently deceased patients with adjoining rooms for use by relatives and in religious practices.

5.50 All of this has important implications for the design of the patient route upon arrival at the hospital, and in particular for the physical and functional relationship between cardiology services provided by the secondary centre and the hospital's A&E department.

Cardiology services at the secondary level

5.51 The cardiology services provided at the secondary level comprise:

- support to accident and emergency services;
- provision of CCU facilities and services;
- consultation services (including outreach consultation services in community hospitals where these are available);
- day care services;
- diagnostic services, including:
  (i) resting, stress and ambulatory ECG;

(ii) echocardiography, including, in some centres only but increasingly, trans-oesophageal echocardiography;

(iii) ordinary chest X-ray – undertaken in the main X-ray department, and under the clinical direction of the head of that department;

(iv) diagnostic coronary angiography; and

(v) nuclear cardiology – undertaken in the nuclear medicine department and under the clinical direction of the head of that department.

- treatment services, mainly medical but including:
  (i) thrombolysis and other parenterally administered drugs;
  (ii) pacemaker insertion and follow-up;
  (iii) in some centres only, imaging-guided PTCA;
  (iv) inpatient services, including high-dependency and standard care.
- rehabilitation;
- follow-up.

Consultation services

5.52 Facilities are required in secondary centres to provide an outpatient service to which patients can be referred by their GP or another consultant for specialist advice regarding the investigation, diagnosis and treatment of CHD or other cardiac disorders.

Day care services

5.53 The day care service provision may often be valuable to cardiology services in the provision of support for day case procedures, which include many investigations and treatments, such as pacemaker work.

Diagnostic services

5.54 Diagnostic services provided within the cardiology department of a DGH include:

Resting, stress and ambulatory electrocardiograms (ECGs)

5.55 The majority of electrocardiograms (ECGs) are taken from resting patients on a couch, trolley or bed in the cardiology department, CCU, A&E department, or on the ward. As resting ECGs may be taken from very ill patients, reliable access to cardiac resuscitation must always be available.

5.56 In stress (exercise or pharmacologically induced) electrocardiograms, an ECG is created while the patient is subjected to exercise-induced stress, treadmill or static bicycle in a dedicated room, normally located in the cardiology department, which is equipped for immediate full CPR and defibrillation. This

implies an area free of obstructions so that the patient may be placed on the floor as required. This is identified as a high priority-design element.

5.57 Ambulatory (Holter monitoring) ECG involves the patient being fitted and electrically connected to a lightweight ECG monitor, following which he or she returns home and undertakes a normal range of activity over a period, usually 24–48 hours, but recent recording advances can now extend this period to up to a week. Following completion of the recording episode, the tape or digital recording is recovered and subject to analysis for ECG waveform abnormalities (PQRST complex) using a computer. This last part of the operation may be undertaken off-site, in a specialist laboratory.

5.58 The alternative of providing ECG services (and other electro-diagnostic services focused on cardiology) from within a central electro-physiology investigations department is a matter for local decision. A majority view within the cardiology community is that such an arrangement is less effective than that of providing all cardiac investigation services from an integrated departmental base, but considerations of location and/or access may impact upon the decision to adopt such an approach.

Echocardiography (ultrasound)

5.59 Echocardiography is used to image and record the action of the heart as it beats, and plays an important role in the diagnosis and assessment of congenital and acquired heart disease. It has the advantage that the patient is not submitted to potentially harmful X-ray radiation and that rapidly moving soft tissue structure, such as valves, can be seen. It is safe, painless and reliable, and may reduce the need for cardiac catheterisation.

5.60 Echocardiography is undertaken on resting patients on couches, trolleys or beds, and, depending on hospital policy, either within a dedicated area within the cardiology department or in the ultrasound department of diagnostic imaging. Portable echocardiography equipment may be used in the CCU, the A&E department, or on the ward. As echocardiography is undertaken on seriously ill patients, reliable access to cardiac resuscitation equipment must always be available. A specialist form using flexible endoscopes technology to allow internal examination is described in the tertiary Section, but may also be undertaken at the secondary level.

Echocardiography room

Nuclear cardiology

5.61 Nuclear medicine involves the study and diagnosis of heart disease by the intravenous injection of a pharmaceutical labelled with a radio-nuclide. The radio-nuclide emits gamma rays, enabling a gamma camera and computer to form an image of the heart. Nuclear cardiology is generally regarded as a sub-specialty of nuclear medicine rather than of cardiology, and will only normally be undertaken in the nuclear medicine department in a DGH. For that reason, and if site constraints allow, there is a good case for providing as direct a link as possible between nuclear medicine, the cardiology department and the CCU.

Chest X-ray

5.62 Cardiac outpatients and emergencies need to have access to standard chest X-ray facilities, which will normally be located in the main X-ray department or, less frequently, in a satellite unit in the A&E department. Cardiac inpatients, including patients in the CCU/intensive care unit (ICU), need to have access to mobile chest X-ray facilities.

Diagnostic coronary and cardiac angiography

5.63 As has already been noted, there is now an established trend for cardiologists trained in angiography techniques. There are now facilities for diagnostic angiography in a few hospitals in Scotland and further development is likely so that it may become available at most DGHs. Such development may have to be linked with other vascular angiography within a diagnostic imaging department.

5.64 An alternative approach would be to use a mobile cardiac angiography suite. This is in a large van which can move from hospital to hospital and would require a dedicated parking area with a service link up. Currently this facility is not frequently used within NHSScotland.

5.65 Cardiac angiography is a technique that involves making an X-ray examination of the chambers of the heart after introducing a radiopaque contrast medium into the blood. The X-ray contrast medium is injected directly into the atria, ventricles or great vessels of the heart by means of a slim sterile flexible tube, a cardiac catheter, which is manipulated into position from an accessible point (usually the femoral artery, but also, though less frequently, from the brachial artery of the arm) over a guide-wire. A recording made by a rapid sequence digital fluorographic technique, called an angiocardiogram, can be stored and viewed via a computer system TV monitor, and may be copied or transmitted to remote TV monitors where it may be viewed by other members of the cardiology team. This form of angiography can be used to study the contraction of the heart and the movement function of the valves. Ventriculography specifically studies the movement and pumping of the lower heart chambers.

5.66 Coronary angiography is similar to general cardiac angiography, but involves a selective injection into the coronary root or individual coronary arteries and is used in demonstrating CHD and in diagnosing and planning the surgical bypass of coronary stenosis or narrowing. An angiogram is also an essential precursor of PTCA intervention, in which a balloon catheter is used to open a stenosis. Angiography is the principal diagnostic tool in acute cardiology and for this reason angiography facilities form an integral part of cardiology provision in cardiac centres.

5.67 Many cardiologists working in secondary centres currently use angiography laboratories located in the main diagnostic imaging department, sharing access with radiologists and other specialists in vascular disease undertaking studies using peripheral angiography techniques, and using modified rather than specialist cardiography equipment. This situation is, however, changing, and it is envisaged that cardiologists working in DGHs will increasingly have access to cardiac-specific angiography equipment used at economically viable levels of activity.

5.68 It should be noted that PTCA and indeed certain other interventional procedures may increasingly take place in NHSScotland hospitals at the secondary or minor level. Although the practice of interventional angiography and of other interventional procedures in private sector hospitals is supported, the physical, operational and governance arrangements in those hospitals are similar to those within NHSScotland.

5.69 All of the diagnostic services described above also aid in the treatment of CHD and help to define both acute and chronic manifestations of heart disease requiring further assessment and/or treatment in a tertiary centre.

Treatment services

5.70 The services that should be available in all secondary centres include the following.

Thrombolysis and other parenterally administered drugs

5.71 The use of thrombolysis in the treatment of cardiac emergencies, particularly early AMI has already been referred to. Secondary centres will in addition provide the full range of medical cardiological services on an inpatient and outpatient basis.

Pacemaker insertion and replacement

5.72 Pacemakers are devices used to produce and maintain a normal heart rate in patients who have a heart defect. Facilities for temporary pacemaker insertion should be available in all centres. In some centres, there will also be a requirement for facilities for the insertion and replacement of permanent pacemakers (see below). The use of a modified form of minor procedures theatre is recommended and described in the Section on tertiary major centres. This is a potentially important improvement in the health estate used for cardiac patient care.

5.73 Permanently inserted 'demand' pacemakers of varying degrees of sophistication are able to sense when a patient's natural heart rate falls below a predetermined value and respond to stimulate the heart. Complex electrophysiological studies have to be completed and interpreted so that the pacemaker can be calibrated to the demands of the individual patient before insertion, and it is for this reason that these pacemakers are normally fitted in tertiary centres.

Inpatient services

General cardiology inpatient services

5.74 Secondary centres will provide inpatient cardiology services from dedicated beds that will normally form part of the hospital's general bed resources.

Intensive and high-dependency nursing

5.75 Reception and treatment of acute presentation of CHD, including AMI, is provided in the CCU.

5.76 Access to facilities for high-dependency nursing of patients with cardiac problems may also be required, although the use of larger CCU facilities able to meet the needs of the full range of patients is recommended.

Rehabilitation

5.77 Advice and assessment of patients by physio and occupational therapists prior to discharge is an important and integral part of the cardiology service. Therapists may in addition provide hospital based outpatient rehabilitation services to patients with cardiac problems post-intervention and/or provide such services on an outreach basis. Cardiac rehabilitation programmes help to achieve better standards of recovery and offer the possibility of an extension to the centre's role, into the prevention of further disease. Psychological care and the involvement of relatives and/or carers is a key part of this process. Health education and lifestyle advice is required, including detailed attention to diet.

5.78 The above applies equally to post-procedure patients referred back to hospital from tertiary institutions for continuing care, and to those who have not needed referral to that level. See also the more detailed description in Section 7.

5.79 In addition to the above, psychological counselling should also be available to patients with diagnosed CHD or who have experienced a cardiac event such as AMI.

Primary care/community follow up

5.80 Adequate follow-up and community support of all patients treated by a secondary centre is important, and provides, along with support for preventative services, the principal opportunity for secondary centres to become closely involved with the primary care sector. For a more detailed discussion of the issues involved, see Section 3.

Facility requirements at the secondary level

5.81 In listing the facilities required to support cardiology services at the secondary level, it is necessary to make a distinction between facilities located on DGH sites, often but not always minor centres, which are the subject of this Section, and those that provide a secondary-level service to locally defined catchment populations from a tertiary site (major centre) alongside and largely subsumed within the facilities provided within the tertiary referral centre.

The British Cardiac Society supports the view that services delivered from DGH sites are most efficiently provided where the main core activities are co-located within a physically identifiable cardiology centre. This centre will form part of a carefully considered and fully integrated matrix of services and facilities serving the wider clinical nursing and rehabilitation needs of the patient as a whole. Such an arrangement is supported on the grounds of:

- patient safety and convenience;
- efficient use of specialist medical and nursing staff;
- dedicated access to specialised equipment;

- the effective deployment of managerial and other physical or service resources.

5.83 It is recognised that not all of the services and facilities which patients need access to during the course of a diagnostic and/or treatment episode can, or should, be centralised within the department. In some cases, the achievement of critical functional relationships necessary for patient safety will outweigh the claims of clinical or operational convenience. In others, clinical governance will reside in another department, and maintenance of clinical standards would be put at risk if the cardiology-related component of the service were to be decentralised. Also, the requirement for access might not justify the cost and probable duplication of staff and other resources that such an arrangement would entail. For this reason, it is necessary to distinguish the resources that should be included within the departmental footprint, and those that can, and perhaps should, be located elsewhere. General X-ray and nuclear medicine are examples of such facilities.

5.84 The facilities that should be located within the cardiology centre on a DGH site are outlined below.

Entrance and patient reception facilities

5.85 Departmental entrance, reception, patient documentation and waiting, with access to public toilets, etc may be able to be provided at a few large tertiary centres in Scotland. In these cases it would be desirable to have a small area set aside for young children who may be accompanying adult patients or relatives, unless such facilities are conveniently close by. There should also be access to vending machines. All patient documentation will be undertaken at the reception desk, as will rebooking of appointments and other clinic administration matters. This area may also contain patient/relative information services and accommodation for patient support groups.

5.86 It is unlikely that DGHs in Scotland will be able to develop separate cardiology outpatient clinics. The trend has been to have such clinics within multi-disciplinary areas. Many of the facilities required for an ECG department eg exercise ECG, cardiac ultrasound and ambulatory tapes need to be available to other consultant staff and not exclusively for cardiology.

Outpatient facilities

5.87 The cardiology outpatient clinic, if included in the department, should provide a minimum of two consulting/examination rooms and associated facilities, including a small sub-waiting area and physiological measurement area including a specimen-taking WC. This should have a hatch connecting it to a sluice/dirty utility room with facilities for urine testing. The scale and size of these facilities will be dependent on patient service provision and the catchment population size and content.

5.88 Consulting/examination rooms should be large enough to allow patient examination seated or reclining with access from at least one side, for the patient to undress and dress behind a drawn cubicle curtain, and for the consultation process to occur with up to three seated people present in addition to the cardiologist or other specialist. Hand-wash basins must be provided in each room. CPR and defibrillation provision must be available.

5.89 There needs to be a conveniently adjacent store/preparation area for clean/sterile products.

Day care facilities

5.90 For reasons of patient safety or convenience most cardiology procedures at the secondary level cannot be undertaken on outpatients, this includes angiography and PTCA where these services are offered. Generally they are undertaken on a day care basis, although some procedures offered at this level can only be undertaken on inpatients. The cardiology service does not require a day care facility dedicated to its use, but will more frequently require programmed access to the hospital's general day care unit.

Facilities for undertaking resting, stress and ambulatory electrocardiography (ECG), and echocardiography

5.91 The various forms of ECG, together with echocardiography, currently provide the basic diagnostic tools of cardiology at the secondary level, and constitute the core facilities that must be provided in an integrated department. Facility requirements are as follows:

Resting ECG

5.92 A room large enough to accommodate three screened cubicles together with a base for the ECG technician, and possibly one other member of staff, is required. Each cubicle must be large enough to accommodate screened patient changing, a couch with access from one side, and the ECG equipment. Facilities must also be available for hand washing. The design of the room should be such that, when necessary, no patient can be observed by another. There must be space and equipment available for emergency resuscitation of the patient by the crash team. An open floor area is needed for CPR or defibrillation. These rooms must be quiet and cool with air-conditioning where necessary, with hand washing facilities.

5.93 In some centres, there may be a preference for each ECG to be undertaken in a separate room, each room being fitted out as above.

Stress or exercise ECG

5.94 A room is required that is large enough to accommodate two or more screened cubicles and treadmills or exercise bicycles with associated equipment, together with a base for the ECG technician and up to two additional members of staff. Each cubicle must be large enough to accommodate screened patient

changing, a couch with access from one side, and the ECG equipment. Facilities must also be available for hand washing. The design of the room should be such that no patient can be observed by another, although the technician must be able to oversee both. Again, CPR and defibrillation and crash call provision must be made.

5.95 In some centres, there may be a preference for each stress ECG to be undertaken in a separate room, each room being fitted out as above.

Ambulatory (Holter monitor) ECG

5.96 Facilities for fitting patients with Holter leads and recording packs, and for storage of Holter monitors, are required. In some centres, these facilities might be shared with others, for example, resting ECG.

Facilities for echocardiography

5.97 A room is required for undertaking echocardiography studies. It must be of sufficient size to accommodate:

- up to three people including the patient;
- screened patient changing;
- a couch with access to both sides;
- echocardiography equipment;
- facilities for the echocardiography technician;
- hand washing facilities;
- space, and equipment, for the emergency resuscitation of patients by the crash team using their equipment.

5.98 In centres offering transoesophageal echocardiography, a second room will be required, similarly equipped, together with facilities for the separate storage and disinfection of endoscopes. In centres where there is more than one endoscopic facility and/or in situations where a suite of endoscopic rooms serves more than one clinical specialty, design teams should consider the option of clustering these so that facilities for disinfection can be shared. Such an arrangement is supported for reasons of patient safety e.g. control of infection, efficient use of disinfecting equipment and effective use of trained staff. More detailed information on this topic is provided in 'Decontamination Guidance', a CD-ROM produced by NHSScotland Property and Environment Forum Executive.

Facilities for angiography, and for image-guided minimally invasive procedures, including angioplasty

5.99 For the purposes of this guidance, it is assumed that ordinary and minimally invasive radiology facilities in secondary centres will be located in the hospital's main X-ray department, and that angioplasty is increasingly undertaken at the secondary level. Although this reflects the current arrangement in the majority

of centres, evidence increasingly suggests that as cardiology services develop at the secondary level angiography and angiography-supported minimally invasive procedures can, and increasingly should, be expanded and possibly integrated with other cardiology services within the cardiology centre. This change in approach is seen to be supported by advances in available imaging technology. The possibility of reconfiguring services to benefit from pooling and networking of specialist resources and trained staff is also identified as being necessary if targets are to be met across the country as a whole.

5.100 The detailed requirements for the design of each of the facilities described above are set out in Section 7 under the relevant headings.

Treatment facilities

Thrombolysis and the administration of other drugs

5.101 These will normally be administered to the patient on a bed/trolley in the CCU. In the case of an emergency/self-referral admitted through A&E it will be in a treatment cubicle in that department. Control of pharmaceutical requirements apply requiring safe storage facilities and accurate record-keeping procedures.

Pacemaker insertion and replacement

5.102 Pacemaker insertion and replacement will take place in a minor surgical procedures room, ideally located adjacent to the CCU. This is a change from previous recommendations. A detailed description of the facilities requirements for this procedure is provided in Section 7.

Angiography and image guided minimally invasive interventions, principally PTCA (see above)

5.103 The physical requirements of the facilities required to support these interventions are complex, and are set out in detail in Section 7.

Coronary care unit

Bed spaces

5.104 In the past, a CCU of 6–8 places has frequently been provided, although consideration of much larger units is now recommended where this may reduce pressure on admission. Project teams should however be aware that a significant increase in the number of CCU beds provided is required in secondary centres if required standards are to be delivered. Requirements will vary, but project teams should assume an ultimate requirement for between 10 and 12 places in each location. See Appendix 2 for typical layouts.

Patient/visitor reception and visitor waiting area

5.105 See other guidance on common shared spaces.

Patient care facilities

5.106 A sufficient number of continuously monitored bed/trolley places to accommodate the anticipated throughput of the unit is required. The majority of places should be provided in an open area, in divided bays, planned in such a way that all bays are visible from the centrally located staff base, and in a manner that enables closely supervised, but not necessarily one-on-one, patient care to be provided for each patient. A minimum of two, and an average of 20–25% of places, should be in the form of single cubicles designed and equipped for barrier and reverse barrier nursing. The radiation protection advisor should be consulted, as mobile X-ray units are frequently used.

5.107 There must be sufficient space around the patient for up to four nurses and/or other staff to gain access comfortably on either side of and behind the patient's head. A substantial amount of stand, trolley mounted and free standing equipment may also be located beside the patient inside the curtained area. The use of gantry mounted instruments and support equipment is now recommended. There must be sufficient space between patients and common equipment to reduce the risk of cross infection. Hand washing facilities in each curtained cubicle and isolation room are essential. Design teams may wish to consider the use of ceiling-mounted pendants in this area, although the amount of equipment and other services used in the CCU is not normally as great as that used in a surgical ICU. It should also be possible for up to two patient relatives/visitors to sit with the patient when curtains are drawn back. Natural daylight, and preferably an outside view, should be provided in all patient areas. The provision of overnight or longer-stay facilities for relatives and carers must be considered.

Staff base

5.108 This must be centrally located, with monitors linked to each patient space and with a clear and unobstructed view of all multi-bed bays and, so far as is consistent with barrier nursing requirements, the single rooms. Resuscitation equipment should be kept in or near to the staff base.

Clean and dirty utilities

5.109 See SHPN 26 'Operating Department'.

Pantry

5.110 See HBN 40 'Common Activity Spaces', Vol. 3 'Staff areas'.

Equipment and other storage facilities

5.111 The design of the storage facilities must not allow clean unused materials to be contaminated by other material.

5.112 The detailed requirements for CCUs are set out in Section 7.

High-dependency beds

5.113 In addition to its ordinary bed complement, cardiology will need to have access to some high-dependency beds. How this access is organised is normally a matter for local decision. Detailed design requirements are set out in Section 7.

Administration, technical and other support facilities

5.114 The following facilities are required:

- offices for clinical, nursing, technical, managerial and other support staff requiring a base in the department;
- an office for administrative staff;
- a seminar/meeting room, unless access to centrally provided seminar/meeting facilities is considered essential;
- staff facilities, rest room, etc., unless adequate access to centrally located facilities is available;
- a cleaner's room.

Relatives' overnight stay rooms

5.115 The provision of these important facilities has not always previously been recognised. As a consequence, the provision of adequate overnight accommodation for relatives across the country is generally variable. A move towards assessing need and making adequate local provision is recommended. These facilities should be adjacent to the CCU where possible.

5.116 Typically these should be bed-sitting rooms, capable of accommodating two people overnight, with en-suite WC, washbasin and shower facilities. Facilities for preparation of beverages and simple snacks should be provided adjacent to these rooms.

Functional relationships

5.117 For the purposes of the guidance offered in this Section, it is assumed that irreducible core cardiology services are provided in the form of an integrated and physically identifiable cardiology department, comprising:

- a department entrance and reception facilities;
- outpatient facilities, unless local hospital policy dictates that these should be located within the main OPD;
- CCU;
- non-invasive diagnostic services;
- facilities for pacemaker insertion and replacement (which should be co-located with the CCU, see below); and

- departmental administration, clinical, nursing, technician and managerial offices (including offices for rehabilitation staff) and other department focused support services.

5.118 In addition to the above, and assuming that space and other practical constraints allow, it would be desirable to include CSSD and, depending on clinical and hospital policy, coronary angiography, if provided, within the departmental footprint.

5.119 For the purposes of this guidance, it is assumed that design teams will ensure that the functional relationships within the footprint are optimised within the constraints of space, access and patient/staff convenience. The following notes are provided to assist in that process.

Department entrance and reception facilities

5.120 The cardiology department entrance and reception facilities should ideally be:

- close to and readily accessible from the main hospital entrance and/or hospital street system;
- close to and with direct access to the department's outpatient facilities; and
- close to and with direct access to the department's non-invasive diagnostic services.

Outpatient facilities

5.121 Unless local hospital policy dictates that these should be located within the main OPD, these should ideally be:

- close to and with direct access from the department's entrance and reception facilities;
- close to and with direct access to the department's non-invasive diagnostic services; and
- close to and with convenient access to the hospital's main X-ray department.

Non-invasive diagnostic services

5.122 Facilities provided in support of these services should ideally be:

- close to and with direct access from the department's entrance and reception facilities;
- close to and with direct access to the department's outpatient facilities;
- close to and with direct access to the hospital's day care facilities; and
- close to the CCU where possible.

Facilities for pacemaker insertion and replacement

5.123 These facilities should be co-located with the CCU, the preferred location.

Departmental administration

5.124 This area should be close to and with direct access from the department's entrance and reception facilities.

Clinical, nursing, technician and managerial offices and other department focused support services

5.125 Facilities should be close to the department's entrance and clinical areas, but capable of being accessed without avoidable contact with patient traffic flows.

5.126 There should be good and convenient access to the CCU, high dependency and general cardiology inpatient areas.

6. Cardiac services at the tertiary level

6.1 The guidance in this Section is provided for the planning and design of services. It includes facilities for the diagnosis, treatment and care, at the tertiary level, or in other 'major centres', of patients suffering from coronary and other heart diseases/heart disorders.

Role of the specialist cardiac centre in the delivery of hospital based services at the tertiary or 'major centre' level

6.2 Tertiary cardiac centres provide specialist investigational and treatment services that cannot usually be fully provided elsewhere because of expense and the need for highly specialised skills and risk control in high hazard procedures. This concentration of services is vitally important in ensuring that acute patients receive high quality care.

6.3 The tertiary centre also serves as a research, training and demonstration site, pioneering new techniques and protocols for the delivery of care, and responsible for the development and dissemination of good practice. For these reasons, it is important that centres maintain close contact with other members of the cardiac community and in particular with those treating patients at the secondary level of care. Education and research facilities will be needed.

Special needs of children and adolescents

6.4 Children rarely suffer from CHD but are instead affected by a substantial range of largely congenital disorders, some of which have a marked or severe effect upon the ability of the heart and lungs to sustain healthy life. The majority of these conditions are diagnosed before or shortly after birth so that treatment programmes may begin very early in life. Special support such as blood oxygenation may be needed. These facilities are fully described in Part 2 of this suite of documents, due to be published later.

6.5 The facilities needed to support these care activities are highly specialised and are provided only in a small number of relatively dedicated institutions. These centres may care for the patient right through to early adult life and although some corrective therapies require little follow up, others need further intervention over long periods of time.

Approach to the delivery of services at the tertiary level

6.6 Tertiary services include those which come under the heading 'Revascularisation' (paragraph 6.7). It is recognised that other tertiary services such as coronary angiography and nuclear cardiography have an important role to play in the delivery of the required standards, particularly in relation to

preventing CHD in high risk patients and in the diagnosis and treatment of patients with stable angina. These services should be delivered to a high technical standard and compassionately by well trained, competent staff. Quality care is seen as dependent on:

- ready access to appropriate services;
- the calibre of interaction between individual patients and individual clinicians;
- the quality of the organisation and environment within which care takes place;
- the action taken to reduce inequalities in health, with resources targeted at those in greatest need and with the greatest potential to benefit;
- CHD policies which are, wherever possible, based on well-conducted, updated, systematic reviews of relevant valid evidence and evolve to incorporate the conclusions of important new research as it becomes available.

6.7 Key investigations and interventions that should be offered to people who are potential candidates for revascularisation and who:

- suffer from angina;
- have unstable CHD; or
- have survived acute myocardial infarction;

are:

- angiography, for those with evidence of continuing extensive ischaemia, and/or angina that persists despite optimal medical therapy and lifestyle advice;

followed by:

- quantitative assessment of urgency/risk/priority for those accepting an offer of revascularisation;

followed by either:

- coronary artery bypass surgery (coronary artery bypass graft (CABG)) for those who meet the criteria for angiography in whom the risks are judged to be outweighed by the benefits in terms of good prognosis or symptom relief; or
- PTCA with or without stenting for those who have continuing symptoms, in whom the benefits are judged to outweigh the risks and who have operable narrowings of one vessel or two coronary arteries without significant narrowing of the left main stem;

followed by:

- effective secondary prevention and rehabilitation.

6.8 This guidance reflects an evidence-based view and is guided by the publications of the British Cardiac Society as to where the distinction lies between services to be provided in a primary care and community setting and those to be provided in the hospital. It does not generally distinguish under the latter heading between secondary and tertiary settings.

6.9 Most tertiary centres offer a range of secondary level diagnostic and treatment services to a geographically defined local catchment population in addition to those of a more specialised nature. Guidance on such provision is in Section 5. It should also be noted that the standards set down and the service models illustrated assume a substantial movement towards complete integration of programmes and approaches across the whole spectrum of heart-related services. This Section of the guidance focuses on those services and facilities that are to be provided by, and in, tertiary care institutions. It is important to recognise that they can only be effective in delivering these standards if they are provided in full partnership with other providers in the primary and secondary sectors.

Cardiac services at the tertiary or 'major centre' level

6.10 Inpatient and outpatient consultation, assessment and treatment, advice on rehabilitation and after-care, along with teaching and research, are important components of the service that is provided by a tertiary centre.

6.11 Diagnostic services will normally include, and concentrate upon, sophisticated procedures which often use expensive equipment or need special expertise. These include cardiac catheterisation and coronary angiography, electrophysiological studies of the heart and echocardiograph. A substantial proportion of these investigations are now undertaken on a day patient basis.

6.12 Therapeutic services will normally include invasive procedures undertaken by cardiologists, for example, coronary angioplasty and complex related procedures, and insertion of complicated pacemaker devices, along with cardiac surgery, which includes procedures undertaken with and without the use of heart/lung machines. Heart and lung transplantation is only provided in a few centres in the UK at the present time, in view of the need to concentrate clinical experience in a field limited by the availability of donor organs.

6.13 The tertiary level services provided, which are the subject of this guidance, are:

- outpatient consultation services;
- inpatient services;
- coronary care unit (CCU);
- emergency services;
- non-invasive diagnostic services:
  (i) nuclear cardiology;

(ii) computed tomography (CT);

(iii) nuclear magnetic resonance (NMR);

(iv) echocardiography;

- invasive radiography services:
  (i) coronary angiography;
  (ii) percutaneous transluminal coronary angioplasty (PTCA);
  (iii) electrophysiology;
- cardiac surgery:
  (i) coronary artery bypass grafts (CABG) using a heart bypass pump;
  (ii) coronary artery bypass grafts using an 'octopus';
  (iii) open-heart valve replacement surgery;
  (iv) organ transplantation surgery;
  (v) great vessel vascular work and some elements of pulmonary surgery;
- other diagnostic and treatment services:
  (i) pacemaker insertion and replacement; and
  (ii) endoscopy;
- intensive and high-dependency nursing services;
- teaching;
- research.

Outpatient consultation services

6.14 The outpatient consultation services that form part of the specialist cardiac centre are similar to those of most other tertiary specialities and may be located either as a stand-alone outpatient clinic suite separately administered and located wholly within the centre, or as a dedicated or shared access facility within the hospital's main outpatient department. Generally, they will conform to the provision set out in other NHSScotland guidance; any minor modifications that may be required are described in Section 7.

Inpatient services

6.15 Inpatient services should be planned and designed in such a way that they form an integral part of a smooth gradient of care that includes:

- closely observed recovery;
- intensive monitoring;
- observation and care of patients having a lesser degree of nursing dependency;

- general care on inpatient wards.

Coronary care units (CCUs) and step down accommodation are key features.

6.16 There are close clinical/functional relationships between each of the above steps, from:

- the closely observed recovery, immediately post-operation of patients who have undergone valve replacement surgery;
- to the close monitoring and observation of patients in the ICU;
- to the observation and care of patients able to move on to step-down (intermediate care) units and CCUs;
- and eventually to cardiac nursing care on the wards.

These are explored in greater detail under the appropriate headings below, and in Section 7.

6.17 The general inpatient care of patients admitted to most specialist cardiac centres will usually take place in dedicated inpatient units that form part of the common bed resources of the hospital. Often, these will be integrated with the remainder of the centre's facilities, and will benefit from good quality communication and access arrangements. Where the opportunity arises, however, a strong case can be made for a closer physical relationship with the intensive and observational components of the care continuum but only if this can be achieved without compromising hospital policy in relation to bed management and overall flexibility of bed use. Inpatient units, wherever located, will normally conform to the provisions set out in other NHSScotland guidance. Any minor modifications that may be required are described in Section 7.

6.18 It is assumed that there will be close correlation between the demand for these services and the provision that is made elsewhere in the centre, and in the wider healthcare economy, for the delivery of the standards overall.

Emergency services

6.19 The great majority of patients who are admitted to hospital CCU departments as emergencies are suffering AMI. A proportion of these patients do not recover. Wherever possible, emergency referrals of patients with confirmed or strongly suspected infarction will be made directly to the CCU department, where appropriate arrangements must be available for their reception. Those arrangements are described in Section 7.

6.20 Exceptionally, chest pain admissions will be made through A&E when there is no spare capacity in the CCU.

6.21 The facilities required in A&E departments for the reception of patients with suspected cardiac disease are described in Section 5.

Non-invasive diagnostic services

Nuclear cardiology

6.22 See paragraph 5.61 for a general introduction.

6.23 The two most commonly used techniques in nuclear cardiology are:

- the multiple-gated arteriography (MUGA) scan, a method of studying the left-ventricular function and wall motion of the heart by injecting a prepared sample of the patient's red blood cells or other agent labelled with radioactive technetium-99 to form an image of the blood pool within the heart at specific points in the cardiac cycle, using an ECG, gamma camera and computer;
- the thallium scan, a method of studying blood flow through the heart muscle (myocardium) and diagnosing myocardial ischaemia (inadequate flow of blood to a part of the heart caused by constriction or blockage of the coronary arteries) using an injection of the radioisotope thallium-201 or a pharmaceutical labelled with technetium. Defects of perfusion (passage of blood through tissue), such as recent infarct (a small localised area of affected or dead tissue produced as a result of inadequate blood supply), emit little or no radioactivity and are seen as 'cold spots' when an image is formed using a gamma camera and computer. Exercise may be used to provoke cold spots in the diagnosis of ischaemic heart disease.

6.24 In addition to those standard techniques, positron emission tomography (PET) is a non-invasive technique that can be used to image or measure the metabolic activity of cells in the human body. Unlike diagnostic techniques, for example, CT or magnetic resonance imaging MRI which produce images of changes in the physical anatomy or structures as evidence of the presence of disease, a PET scan is a simple and low-risk procedure that involves the introduction of a small amount of radioactive material, usually Flourine 18, into the patient's bloodstream, usually by injection. A specially designed tomographic positron camera is used to image the isotope distribution. The use of PET in cardiology is not common or proven at this time of writing.

6.25 Nuclear cardiology is a sub-specialty of radio-nuclide scanning (nuclear medicine) rather than of cardiology, and members of the cardiac community generally prefer it to be included with that specialty, rather than forming part of a cardiac centre. This will usually be the preferred option where an existing department is large enough to handle the cardiology workload and is conveniently located. Local consultation is recommended.

Note: The use of mobile gamma cameras in CCU has been demonstrated as useful in some key centres.

6.26 Such an arrangement can also be justified by the need to make optimal use of expensive equipment and specialist staff, and for reasons of quality control. Reinforcement for that view comes also from current developments in MRI,

which may overtake cardiac isotope scanning as a high-quality diagnostic tool, rendering satellite units obsolete. Radiation-protection arrangements are again important and must be discussed with the local RPA.

Computed tomography

6.27 CT is a specialised form of X-ray examination in which the X-ray source and detector (CT scanner) rotate around the object to be scanned and the information obtained used to produce cross-sectional images (CT scans) using a computer. The patient receives a higher radiation dose than with conventional X-rays, but the diagnostic information obtained may outweigh the additional risk. Spiral CT scanning (helical CT scanning) is a development of conventional CT in which the X-ray tube rotates continuously around the patient as he or she passes through the scanner on a moving couch. This allows the acquisition of images throughout a specified volume of tissue. Since these images are digitally acquired they can be post-processed to produce images in numerous planes without further exposure of the patient. Electron beam based CT has also been applied in cardiology as described below.

6.28 Developed in the USA some 15 years ago, electron beam tomography (EBT) uses an electronically steered electron beam to create X-rays that pass through the patient to form the CT image. It is claimed that the technique is able to accurately detect coronary artery disease, but binding evidence to support this view has not been located. A unit has been evaluated at the Brompton Hospital, London.

6.29 Although useful, CT is not yet a substitute for other investigative techniques in cardiology. Nuclear MRI is of increasing interest in cardiology and has been demonstrated to be useful in valve disease diagnosis and in a number of congenital disorders. However, MRI is not yet proven to be of value in CHD diagnosis, although progress in development continues.

6.30 Except in the most specialised centres, cardiologists are likely to have to share access to scanners. This suggests that a location within the main diagnostic imaging department might be the preferred siting, in view of the need to make efficient and economic use of trained staff and equipment.

Echocardiography

6.31 See paragraphs 5.59 and 5.60 for a general description of echocardiography. M-mode echocardiography uses a single beam of ultrasound and produces an image that is not anatomical but permits precise measurement of cardiac dimensions and the diagnosis of valvular, myocardial and pericardial disease. Real time echocardiography uses a pulsed array of ultrasound beams to build up a moving image on a TV monitor of the chambers and valves of the heart. In Doppler echocardiography, ultrasound reflected from moving red blood cells is subject to the Doppler effect (change of pitch with velocity relative to the observer), which can be used to calculate blood flow within the heart and great vessels. The use of internal flexible endoscopes to support probes is described in Section 5.

Angiography services

6.32 The three principal invasive techniques involving radiography that are used in cardiology are:

- coronary angiography;
- percutaneous transluminal coronary angioplasty (PTCA)/stenting, using angiography for catheter placement; and
- electrophysiological studies, using angiography for electrode placement.

Coronary angiography

6.33 See paragraphs 5.63–5.69 for a general description of angiography.

6.34 The main references are made under the generic heading 'Revascularisation', under that heading it is recommended that angiography be available as a diagnostic support to programmes for improving the services offered to persons at risk of CHD or suffering angina.

6.35 These facilities will in a number of locations only be achieved in stages over a period of time, eventually leading to the ultimate goal regarding treatment within stable timescales.

Percutaneous transluminal coronary angioplasty (PTCA)

6.36 Angioplasty is a minimal invasive procedure that opens, without the need for thoracotomy, narrowed or completely obstructed arteries resulting from degeneration of the walls due to the formation of fatty plaques and scar tissue. In PTCA, 'balloon angioplasty', an inflatable balloon mounted on the tip of a flexible catheter is placed within the lumen (cavity) of the affected artery, at the site of the disease, under image control (for description of catheter placement, see paragraph 5.65). On inflation of the balloon, the lumen is enlarged, disrupting the inner wall of the artery, which reduces the chance of further narrowing. The site of the obstruction is identified by prior coronary angiography. The technique is also used to evaluate the outcome from PTCA.

6.37 It is recommended that each individually trained operator at consultant level should perform a minimum of 75 angioplasties per year. Each single institution undertaking PTCA should carry out a minimum of 200 procedures per year with a minimum of two operators.

6.38 PTCA should be performed only with pre-arranged surgical cover and in institutions where emergency cardio-pulmonary bypass can be established within 90 minutes of the decision to refer the patient for emergency CABG. If inter hospital transfer is required, the journey time between hospitals should not exceed 30 minutes.

Electrophysiology

6.39 In electrophysiology studies designed to record the electrical activity of the heart during the cardiac cycle, electrodes are introduced into the chest cavity and placed on the surface of the heart under radiographic control using angiography. Vascular introduction is also utilised. The waveform of electrical impulses from different parts of the heart surfaces generated during the cardiac cycle, which takes about a second, are detected separately and can be turned into a continuous display, the data also being recorded for later analysis.

6.40 When the conductive tissue has become damaged, electrophysiology is undertaken to discover the extent of the damage. This may be followed by septal oblation, in which further controlled sacrifice of the septal tissue is carried out in order to improve heart rhythm and possible output.

Transoesophageal echocardiography

6.41 Transoesophageal echocardiography is a specialised technique in which ultrasound is used in conjunction with endoscopy. The probe is introduced using a flexible endoscope.

Intravascular ultrasound cardiography

6.42 Originally developed as a research tool for pharmaceutical studies, contrast agent imaging using ultrasound can now be used to enhance images of structures and blood flow to an extent not previously possible in that medium. The techniques are under evaluation at this time of writing.

Cardiac surgery

6.43 Cardiac surgery has traditionally been grouped with thoracic surgery, and there is an increasing tendency for convergence with pulmonary and vascular work. However, although requiring close access to some services provided by the cardiology department, cardiac surgery has generally been seen as a specialty within surgery rather than an integral part of cardiology and this is likely to continue to be the case in all but the most specialised centres. The procedures that are covered by this guidance are:

- Coronary artery bypass graft (CABG) using a heart bypass pump;
- CABG using an ‘octopus’;
- open-heart valve surgery;
- organ transplantation surgery; and
- great vessel vascular work, and some elements of pulmonary surgery.

Coronary artery bypass graft using a heart bypass pump

6.44 CABG is a form of coronary revascularisation in which a segment of a coronary artery narrowed by atheroma, degeneration of the walls of the arteries due to the formation of fatty plaques and scar tissue, is bypassed by an autologous (donated by the recipient) section of healthy vein or artery, usually at a

thoracotomy (surgical opening of the chest cavity). The improved blood flow resulting from one or more such grafts relieves angina pectoris (chest pain) and reduces the risk of myocardial infarction (heart attack).

6.45 In view of the powerful pumping action of the heart and the delicate nature of the surgery that is involved in attaching the new healthy material to the artery, it is necessary to dampen, or stop, the action of the heart while this work is carried out. There are two principal techniques for supporting blood circulation through the body while CABGs are being performed. Currently, the most frequently employed technique involves circulating the whole of the patient's blood supply through an externally attached mechanical heart pump, perfusion/oxygenation machine, in order to allow the heart to be made temporarily inactive through the use of an injected drug while the operation is being carried out. The second, more recently introduced technique reduces the need to stop the heart. It involves instead, the use of a device known as an octopus, which surrounds the heart mechanically and which, through the strong supporting action of up to eight 'legs' that attach to the external surface of the heart, limits movement of the heart muscle at the point of attachment.

Coronary artery bypass graft using an octopus

6.46 Use of the octopus device allows operations to be completed in shorter time, and carries less risk of postoperative morbidity. It is likely, therefore, that in the future, as more cardiothoracic surgeons become trained in its use. Using an octopus will become the preferred technique, but it is most unlikely to wholly replace the bypass method.

Open-heart surgery for valve replacement

6.47 During open-heart surgery for valve replacement, the heart itself is opened in order to access and replace defective valves. For this reason, the theatre environment within which such operations take place must be of a substantially higher standard than that which would be acceptable for the carrying out of CABGs, where the chest is opened but the heart remains closed. As with CABG, however, the pumping action of the heart must be bypassed while the valve is being replaced.

Organ transplantation surgery

6.48 While guidance on the design of facilities for organ transplantation is specifically excluded from this guidance, organ transplantation services are clearly an integral part of a comprehensive cardiac service. At the present time, the programme only operates from a small number of designated centres in the UK, and this is likely to be the case for the foreseeable future. This subject is explored later in this guidance.

Great vessel and pulmonary surgery

6.49 In a number of centres in the UK, great vessel and some elements of cardio-pulmonary surgery are carried out in cardiac centres. Specific guidance on the design of theatre facilities for this work is specifically excluded from this

guidance, but facility requirements generally are similar to those for CAGB surgery.

Other diagnostic and treatment services

Pacemaker insertion and replacement

6.50 Pacemakers are devices used to produce and maintain a normal heart rate in patients who have a heart blockage. The unit consists of a power source that stimulates the heart through an insulated electrode wire attached to the surface of the ventricle (epicardial pacemaker) or lying in contact with the lining of the heart (endocardial pacemaker). Temporary pacemakers have an external battery and stimulate the heart at a fixed rate. Demand pacemakers are permanently implanted under the skin. They sense when the natural heart rate falls below a predetermined value and then stimulate the heart. The procedure is normally carried out by a cardiologist in the angiography suite or in the recommended minor procedure room using a mobile image intensifier. The need to observe proper infection control procedures in the design of these facilities is emphasised.

Endoscopy

6.51 Endoscopy involves the use of an endoscope, a tube with a light at the end and an optical system using fibre optics and a miniature video camera for transmitting images to obtain a view of the interior of the body. Endoscopy is not a first line diagnostic technique in cardiology, but is used in a number of support roles, particularly in identifying post-operative complications in cardiac surgery. It may also be used to distinguish cardiac related chest pain from that caused by inflammation due to the pacemaker insertion, and/or replacement, procedures.

Cardiac nursing

6.52 For the purposes of this document, cardiac nursing is regarded as a part of the continuum that runs from observed recovery in the post-operative recovery area, through intensive care to step-down, intermediate care, units and CCUs.

Post-operative recovery

6.53 It is important to note that a patient's stay in critical care is relatively short and only a first staging post in a more extended process of recovery that will, in almost every case, require an extended period, sometimes many weeks, in intensive care. This will be followed by periods of care in step-down, intermediate care, units and/or CCUs. To achieve a swift transfer between these two stages of care, the two facilities should be physically close, ideally contiguous, and should involve a minimum of patient movement.

Intensive care

6.54 Patients in intensive care or therapy will receive close 24-hour individual monitoring over what may be extended periods, and may require emergency transfer back to theatre for urgent life saving intervention. Other urgent interventions not requiring the facilities of an operating theatre may need to occur within the ICU itself. In major centres, particularly those that are being constituted as self-contained units, the ICU will be dedicated to patients with cardiac problems. Where this is not the case, it is usual for a number of ICU beds to be dedicated for cardiac intensive care. Increased provision in this area is becoming necessary and should be evaluated locally. This may be an important factor in waiting list reduction.

Services to be supported at the tertiary level

6.55 Most centres providing diagnostic, treatment and rehabilitation services at the tertiary level provide services at the secondary level also. Where this is the case, there can be significant benefits in terms of service delivery, utilisation and management of resources. However, all DGHs operating at the secondary level provide important diagnostic and treatment services including minimal invasive therapy, while larger secondary centres may offer more complex invasive techniques up to and including coronary angioplasty. The facility requirements of cardiac services for children and for organ transplantation are highly specialised and will be covered in future guidance.

6.56 Centres operating at the tertiary level must be able to provide services that consist of three equally important and inter-related parts:

- high quality clinical diagnostic, treatment and rehabilitation services;
- research and development in order to improve cardiac services and their delivery to the patient. In most cases, this research will be clinically oriented, but some basic biological research will also occur in some centres;
- teaching to all staff, medical, nursing and other groups, to ensure that services are provided in accordance with the latest knowledge.

Specialist investigation and treatment

6.57 A tertiary centre will also provide special expertise in uncommon cardiac conditions, such as forms of heart muscle disease, heart disease in pregnancy and specific cardiac rhythm disorders. Thoracic surgery is increasingly combined with cardiac surgery, and some but not all centres will provide this service. Heart and lung transplantation is provided in this country in a few centres only, in view of the need to concentrate clinical expertise in a field limited by the availability of donor organs.

Clinical research and development

6.58 Clinical research is one of the core functions of all tertiary or other cardiac centres. On the one hand, developments in the health and life sciences increasingly demand a strengthening of links between the basic and clinical sciences, while on the other standards of clinical care and training can only be achieved if there is a close interaction between research, development and clinical practice. Such interactions have spatial as well as operational implications, and present a considerable challenge to planners and designers. In many older centres of high reputation the physical arrangement of the facilities that have developed over the years do not lend themselves to these arrangements.

Teaching

6.59 A tertiary centre has an important role to play in teaching. This role will normally encompass teaching of all staff groups involved in the provision of cardiac services, including:

- undergraduate, general postgraduate and specialist medical training;
- basic and post-basic specialist nursing training;
- training of professions supplementary to medicine, in particular perfusionists, medical technical officers and cardiographers.

Approach to the provision of design guidance

6.60 The programme of capital investment required to ensure that the health estate can deliver improved standards at the tertiary level, must be spread among a large number of centres. Many are already fulfilling, in substantial measure, the service delivery standards that are required. However, almost all are constrained and in some cases compromised, by estates limitations.

6.61 For the above reason, the guidance that is offered here assumes a flexible and incremental approach to healthcare facility development, in addition to starting with the concept of an 'ideal' whole. The guidance is organised around a 'catalogue' of functionally related suites of spaces that combine together to form functionally interdependent but relatively self contained modules that can be assembled in different combinations as circumstances require. It is intended by this means to assist project teams to achieve highly differentiated solutions that reflect the constraints and opportunities afforded by each individual site in the context of the specific requirements of the client brief. These, taken in conjunction with the services and facilities that already exist, approximate to a topologically recognisable ideal in every material respect. The pursuit of new build cardiac facilities projects will often be preferred.

Facilities to be provided in support of services at the tertiary level

6.62 For the purposes of this guidance, and for the sake of completeness, the descriptions of facility requirements that follow in Section 7 assume an independent cardiac centre to be newly constructed on an existing teaching hospital site. This will be offering a comprehensive tertiary referral, diagnostic, treatment and rehabilitation service to a geographically broadly based catchment population, as well as providing a similar range of services at the secondary level to a local catchment population. While this will not be typical of all of the projects to which this guidance will apply, it has the benefit of demonstrating a range of facilities in such a way as to illustrate their essential requirements, the benefits of integration and alternative options for configuration. It will also be noted that a further assumption built into the model is that in a new centre, where such an arrangement is feasible and appropriate, cardiology and cardiothoracic services will share the facilities in order to avoid duplication and to increase opportunities for cross disciplinary collaboration.

7. Built environment and facility descriptions

Introduction

7.1 This Section of guidance is concerned with the facility requirements of hospital based cardiac services at the tertiary level. It is intended primarily as a design guide and checklist for professionals involved in the planning and design of such facilities, and for members of project teams responsible for their procurement. More general planning issues, as these relate to the services provided at this level, are dealt with in Section 6. See also Appendix 2 'Room layouts'.

Categories of facilities

7.2 The following categories are used to differentiate between cardiac specific facilities and those facilities that are common to a number of clinical service and support departments. Proper control of infection procedures must be observed in the design of these facilities, their equipment and finishes. This is particularly important in areas where resuscitation or invasive procedures may be carried out. More detailed notes are provided under the individual facility descriptions, also refer to SHFN 30: 'Infection control in the built environment'.

Category 1

7.3 Services and facilities to which non-dedicated access must or may need to be available during the course of a cardiac patient episode are Category 1. These services may be located in both secondary and tertiary level centres; examples include non-dedicated outpatient services, accident and emergency services, non-specialised diagnostic imaging and laboratory services. Generally, these facilities do not require any adaptation to the needs of cardiac patients, and guidance on the design of these facilities is available in other Scottish planning and engineering guidance. Guidance on the extent of any adaptations that may be necessary within existing departments to meet project specific requirements that may reflect, for example, opportunities for joint use of facilities or other operational considerations, is to be found under the relevant headings in other parts of this document, although in most cases those adaptations will draw heavily on other guidance.

Category 2

7.4 Services and facilities used by many other departments of the hospital to which appropriately managed and possibly dedicated patient access must or may need to be available during the course of a cardiac patient episode are Category 2. These services may be located in both secondary and tertiary level centres; examples include cardiac inpatient services and cardiac operating

theatres, which will generally form part of a larger inpatient or operating theatre complex in which many of the facilities are shared. In many cases these facilities will not require any adaptation to the needs of cardiac patients, they may be treated as Category 1. In some cases, adaptation will be necessary, and guidance on this can be found under the relevant headings in other parts of this document, although in most cases this will involve the use of rooms that are already specified in guidance for other departments within the hospital.

Category 3

7.5 Services and facilities that lie wholly within the clinical governance of cardiac service providers and which must or may need to be available during the course of a patient episode are Category 3. The majority of these services will be located in tertiary referral centres; examples include the angiography suite and CCU. Guidance on the facilities requirements of these services is to be found under the relevant headings in other parts of this document, although in many cases this will involve the use of rooms that are already specified in guidance for other departments within the hospital.

Main entrance, reception and administration offices

General

7.6 This area may be Category 3, it may be shared with other services or it might be a function of the main hospital entrance, in which case it is Category 2. It provides a focal point for the services provided by the centre.

Functions

7.7 All visitors must be received in a manner that is reassuring and minimises anxiety, affords privacy and confidentiality of information, and involves collection of information that is as quick and accurate as possible. Facilities for the purchase of beverages and snacks, and for their consumption in suitable surroundings, should be provided. Visitors must be able to find their way to their intended destination with minimum effort and there must be disabled access to all of the facilities offered.

7.8 There must be a covered drop-off point for ambulances and other vehicles delivering patients to the centre.

7.9 The reception area provides a base for associated staff, such as porters.

7.10 This area accommodates important administrative procedures including:

- providing clear directions;
- providing ‘help desk’ facilities for visitors with queries;
- issuing official visitors with security badges;

- providing a switchboard and paging service for the centre;
- registration of patient information on the Patient Administration System (PAS);
- management of patient medical records whilst these are in the department.

Components

7.11 These must all include provision for the disabled, and they are:

- reception and waiting facilities with patient and visitor WC facilities nearby;
- admission facilities;
- general office space;
- medical records storage; and
- refreshment facilities.

Functional relationships

7.12 The main entrance, reception and administration offices should:

- preferably be close to car parks for both patients/visitors and hospital car/ambulance services or have designated drop off facilities;
- have direct and simple access to all Category 3 dedicated patient related diagnostic, treatment and rehabilitation services located within the centre;
- have simple and convenient access to all Category 2 patient related diagnostic, treatment and rehabilitation services located outside the centre but within the hospital; and
- provide reasonably convenient access to all Category 1 patient related diagnostic, treatment and rehabilitation services located outside the centre but within the hospital.

Cardiac/cardiothoracic outpatient department

General

7.13 The outpatient department (OPD) is Category 3. For the purposes of this guidance, it is assumed to be a stand-alone facility located in the specialist centre. An alternative location may be within the main hospital OPD with dedicated access, Category 2. Exceptionally, the clinic may share access with cardiopulmonary or other closely related specialities, in which case any special requirements of the other user(s) must be identified.

Functions

7.14 These are:

- to provide an outpatient service to which patients can be referred by their general practitioner (GP) or another consultant for specialist advice regarding investigation, diagnosis and treatment;
- to provide facilities for clinical teaching and research.

Components

Reception and administration facilities

7.15 A patient and visitor waiting area, play area and refreshment facilities (vending machines) should be provided. WC facilities should be nearby, including provision for the disabled. These may be part of main hospital OPD or combined with other outpatient services, e.g. the chest clinic, depending on Trust policy. The design should provide a quiet, relaxed atmosphere, with a welcoming and pleasant reception and waiting area. An excessively clinical appearance should be avoided, but facilities for hand washing must be provided. External views are generally regarded as essential.

General clinic room

7.16 Height and weight measurement facilities, venepuncture facilities and a specimen-taking WC, with facilities for hand washing, should be available.

Consulting/examination rooms

7.17 At least one room should be large enough to accommodate a bed/stretcher for use by the transplant clinic, and a proportion of the rooms should be large enough to accommodate students for teaching purposes. Facilities for hand washing must be provided.

Patient education room and counselling room

7.18 This area may be shared with other clinics.

Clean utility room

7.19 Storage space must be provided for sterile supplies, drugs, dressings and sundries, in a clean utility room and elsewhere. The clean utility room will also provide controlled drugs storage, this may also serve the cardiac non-invasive investigations unit. Facilities for hand washing must be provided.

Dirty utility room

7.20 This room should include a hatch to a specimen-taking WC. Facilities for hand washing must be provided. Flexible scopes and all other instruments must be decontaminated in the Sterile Services Unit (SSU).

Disposal room

7.21 As described in SHPN 12: 'Out-patients department'. Facilities for hand washing must be provided.

Cleaner's room

7.22 This may be shared with other clinics, depending on location.

Staff accommodation

7.23 An OPD manager's office, nurse manager's and sisters' offices, visiting staff and consultant's offices may be shared with other clinics, depending on hospital policy and location. A staff rest room with beverage bay may be shared with other clinics, depending on location.

Special features

7.24 These are as follows:

- all clinic areas will have colour corrected lighting;
- proper control of infection procedures must be observed in the design of these facilities, their equipment and finishes;
- consulting/examination rooms must be capable of being blacked out and must have hand washing facilities.

Functional relationships

7.25 Regardless of location, the cardiac/cardiothoracic OPD should:

- be close to the main entrance and car parking, including disabled parking; (see paragraph 7.12);
- be contiguous with the cardiac non-invasive investigations unit and close to other investigation facilities, including radiology, nuclear medicine and laboratories, the latter may, however, be achieved by use of a pneumatic tube;
- be close to a pharmacy;
- provide reasonably convenient access to restaurant, snack and beverage facilities.

Day case unit

General

7.26 The day case unit is Category 3. For the purposes of this guidance, it is assumed to be a stand-alone facility located in the cardiac centre. An

alternative location may be a centrally located facility in the main hospital if conveniently adjacent i.e. Category 1. If Category 3, it is assumed that facilities for the day care of other patients will be provided elsewhere in the hospital.

Functions

7.27 This area is designed to manage day case admissions, providing accommodation for patients requiring investigation or treatment that involves an element of recovery, but which can be completed without overnight use of a ward bed.

Components

Reception/waiting facilities

7.28 Reception and waiting facilities may be located here or in the catheter laboratory, if adjacent.

Bed area

7.29 Multi-bed space with accommodation for 8–12 beds or reclining chairs in four bed/chair bays should be provided. Oxygen and medical vacuum outlets should be provided at each bed-head and lighting should be colour corrected. Clinical hand washing facilities must be provided. Care must be taken to ensure sufficient space to allow proper control of infection procedures to be observed. Personal washing, showering and WC facilities should be provided with ease of access from the bed areas and these must also be suitable for the disabled.

Staff base

7.30 The staff base should be centrally located, overlooking the bed area, with desk space for three persons and surveillance of patient/staff call lamps and the controlled drugs cupboard.

Clean utility room

7.31 This should include a drugs fridge and storage facilities for sterile supplies. Hand washing facilities must be provided.

Dirty utility room

7.32 This should include a slop-hopper, facilities for bedpan decontamination and facilities for urine testing. Hand washing facilities must be provided.

Treatment room

7.33 As described in HBN 40: 'Common Activity Spaces' Vol. 2 'Treatment areas'.

Patient lounge and beverage bar

7.34 This may be shared with an adjacent department.

Counselling room

7.35 A quiet, private space should be provided for counselling.

Storage, disposal and cleaning facilities

7.36 Storage, sized to suit the unit and to minimise any risk of infection of clean/unused items, should be provided.

Special features

7.37 These are as follows:

- bed areas should be designed to allow interchangeable use of beds/reclining chairs;
- bed areas must be large enough to prevent cross-infection and also to accommodate relatives and escorts who may wish to spend a substantial part of the recovery period with the patient;
- staff call buttons should be provided throughout the patient accessible areas;
- defibrillation equipment should be kept close to the staff base;
- clinical hand washing facilities must be provided.

Functional relationships

7.38 The day case unit:

- must be close to, preferably contiguous with, cardiac catheter laboratories (principal relationship);
- should be close to relevant investigation and treatment departments including cardiothoracic operating theatres;
- should be conveniently close to restaurant and snack facilities.

Cardiac non-invasive investigations unit

General

7.39 This unit is Category 3. If circumstances permit, this unit should be planned to be contiguous with the day case unit, and the cardiac/cardiothoracic OPD, with which it may share many facilities, for example reception, waiting and many of the supporting services already described. The following list of requirements is

based upon the assumption that this will be the case. Only the additional, dedicated non-invasive investigations unit facilities are dealt with in this Section.

Functions

7.40 These are:

- to provide for the investigation of inpatient and out-patient cardio-respiratory status, including resting, exercise and 24-hour ambulatory ECG, pacemaker analysis, echocardiography and Doppler ultrasound, oxygen consumption tests and Holter laboratory tests;
- to provide facilities for clinical teaching and research.

7.41 Resting ECGs, some pacing checks and some echocardiographs will also be performed on the cardiology and cardiothoracic wards, the coronary care, intensive care, progressive care and day care units, operating theatres and A&E, neonatal and outpatient departments. ECG machines are wheeled to all departments and ease of access is required. It is assumed that lung function testing will be undertaken elsewhere.

Components

Entrance/waiting area

7.42 Sub-wait and sub-reception facilities should be provided in addition to the main facilities provided in the OPD, along with patient WCs and changing facilities, including facilities for the disabled.

Electrocardiography possibly with telemetry

7.43 In a major centre, a minimum of four rooms will be required. Each space must be adequate to accommodate the patient, operator, occasionally a cardiologist and the use of emergency resuscitation equipment by a crash team when required. An area of 16m^2 for each room or bay should be sufficient to accommodate these functions.

Equipment

7.44 Equipment and furniture will include trolley-mounted ECG equipment, defibrillator, a free standing couch offering all round access to the patient, together with facilities for the ECG technician and some local storage. Hand washing facilities must be provided.

Services

7.45 Services must include oxygen and suction outlets to each couch and a minimum of eight double electrical socket outlets. Sound attenuation and independent climate control is required in these rooms. Light and other electrical fittings should be compatible with clinical equipment with low

electronic 'noise' levels. The use of 'clean' earth connections is essential with this equipment; this may be obtained by the application of the zonal earthing strategy described in the BS 7671:2001 Requirements for Electrical Installations, IEE Wiring Regulations, 16th edition.

Echocardiography

7.46 In a major centre a minimum of four rooms or bays will be required. Each space must be adequate to accommodate patient, operator, occasionally a cardiologist and the use of emergency resuscitation equipment by a crash team when required. An area of 18m^2 for each room or bay should be sufficient to accommodate these functions.

Equipment

7.47 Equipment and furniture must include echocardiograph equipment, trolley mounted 12-lead ECG (where this is not integral with the echocardiograph equipment), defibrillator, free standing couch offering all round access to the patient together with facilities for the echocardiograph technician and some local storage.

Services

7.48 Services will include oxygen and suction outlets to each couch and a minimum of eight double electrical socket outlets. Light and other electrical fittings should be compatible with clinical equipment with low electronic 'noise' levels. Lighting should be incandescent with dimmer control. The use of 'clean' earth connections is essential with this equipment (see paragraph 7.45).

7.49 An alternative to the arrangements for echocardiography and ECG described above that might achieve some economies of scale or flexibility in the allocation of rooms is to provide a suite of similar rooms that can be used interchangeably for either function. Modern echocardiography machines normally include colour Doppler and continuous ECG recording and printing modules, so that extra space would not be required to accommodate these functions, and the area of 18m^2 appropriate for ECG would be sufficient for both. It will be noted that the servicing arrangements for both diagnostic modalities are identical, except that all rooms under this arrangement would have to have dimming equipment.

7.50 Further economies might be achieved if each dedicated ECG room were able to accommodate two patients simultaneously. An area of 20m^2, with a dividing curtain between couches, would be sufficient to accommodate this arrangement.

ECG exercise room

Exercise ECG room

7.51 In a major centre, space may be required for a minimum of two treadmills and one exercise bicycle. The room should be divided into cubicles, each cubicle large enough to accommodate a couch, treadmill/exercise bicycle and associated equipment, as well as up to three people in addition to the patient. A defibrillator should also be available within the room. Patients should not be able to see each other, but a senior technician should be able to see all patients.

7.52 The provision of a Local Area Network (LAN) will be required to facilitate central analysis and storage of stress ECG data. The majority, but not all, modern systems will meet Institution of Electrical Engineers' standards.

Services

7.53 Services will include oxygen and suction outlets, staff and emergency call outlets, and sufficient electrical outlets to accommodate all equipment, including stress-testing equipment. Hand washing facilities, worktop and local storage facilities should be provided. Air conditioning with independent climate control is required in this room. Light and other electrical fittings should be compatible with clinical equipment with low electronic 'noise' levels.

7.54 It is occasionally necessary to undertake life-saving procedures in this room. Its design and location within the department should ensure that it is easily accessible to staff who may be involved in resuscitation of a collapsed patient, and clear from bulky equipment that may hamper the process. It is most important that wall and floor finishes should therefore be hygienic and easily cleanable.

Pacemaker follow-up and treatment suite

7.55 In a major centre, space will be required for a minimum of three cubicles and associated dedicated storage. Hand washing facilities must be provided. This room can also be used for general consultation purposes. Independent climate control is required in this room.

Chest X-ray facilities

7.56 The provision of dedicated minor X-ray facilities for cardiology is no longer supported. Patients should be provided with appropriate X-ray facilities in the main radiology department.

Endoscopy procedures relating to cardiology

7.57 Endoscopy procedures, including tranoesophageal probes, will be carried out in endoscopy suites. These are described in SHPN 52 'Accommodation for day care', Part 2 Endoscopy unit. Facilities will be provided for patient reception, preparation and recovery, possibly shared with other services such as insertion and/or replacement of pacemakers, for undertaking the procedure, and for the storage and cleaning of endoscopes. Clinical hand washing facilities must be provided.

Holter room

7.58 This room should include cubicalised spaces for the fitting and recording of 24–96 hour ambulatory ECG tapes. After removal from the patient these are usually sent off-site for analysis. In most departments, two such spaces should be adequate. Hand washing facilities must be provided.

Echocardiograph viewing room

7.59 This room should include two air-conditioned workspaces and room for up to six people standing.

Pacing clinic workshop

7.60 This must accommodate up to three people, one patient sitting, and up to two technicians, with desk or worktops, desktop computer and other equipment.

Patient interview room

7.61 A quiet, private space should be provided for patient interviewing.

Staff accommodation

7.62 Multi-occupancy rooms to accommodate technicians' and administrative offices, secretarial offices, etc. It is assumed that the consultants' offices will be located centrally in the department.

Enclosed decontamination unit for flexible endoscopes and endoscope storage rack

Endoscopy camera and trolley unit for echocardiography

Storage facilities

7.63 Storage facilities will be required for endoscopes, usually in the endoscope cleaning room adjacent to the procedures room; see also HBN 40: 'Staff areas' Vol. 3.

Special features

7.64 These are as follows:

- colour corrected lighting is required in all clinical and clinical support areas;
- piped oxygen and vacuum is required in the exercise room;

- crash call buttons will be required throughout the department in patient accessible areas.

Echocardiology laboratory equipped for side-scan oesophageal endoscopy

Cardiac isotope scanning department

General

7.65 This department is Category 3. Cardiac isotope scanning is a sub-specialty of radio-nuclide scanning (nuclear medicine) rather than of cardiology, and a location within that specialty will usually be the preferred option where an existing department is large enough to handle the cardiology workload and is conveniently located. A brief note is included, listing what would be required if the facility were to be located within a specialist cardiac centre. For further information also see SHPN 06: 'Facilities for diagnostic imaging and interventional radiology'.

Functions

7.66 These are:

- to provide a safe and efficient service for patients, normally adults, who require cardiac-specific isotope scanning with a gamma camera. Patients will attend on a selective basis, after other investigations have been carried out, and as a result of prior consultation;
- the administration of multi-gated arteriography and thallium scans, and in some centres positron emission tomography using a specially designed tomographic camera;
- to provide facilities for clinical teaching and research.

Components

Entrance/waiting area

7.67 Sub-wait, sub-reception facilities, patient WCs and changing facilities should be provided, including facilities for the disabled. A separate waiting area and WC should be provided for use only by patients undergoing isotope scanning procedures. Facilities are required for the secure reception of isotopes delivered in lead-lined containers.

Preparation/injection/exercise stress room

7.68 This should be large enough to accommodate the patient and technician, exercise bike, or similar stress inducer, hand washing facilities, worktop and local storage facilities including dose storage. Services will include oxygen and suction outlets, staff and emergency call outlets, and sufficient electrical outlets to accommodate all equipment including stress testing equipment. An area of approximately 24m^2 will be required for this facility. A disposal area with lead-lined storage bins for used isotopes must be provided here or in an adjacent area.

Gamma camera room

7.69 This should be large enough to provide all-round access to the imaging couch and gamma camera with moveable 'C'-arm, control equipment, computer, technicians' workspace, hand washing facilities and local storage. A minimum area of 33m^2 will be required for this facility. Services will include oxygen and suction outlets, staff and emergency call outlets, and sufficient electrical outlets to accommodate all equipment, including stress inducing equipment if located in this room.

7.70 In some facilities, the reception, preparation, measurement, injection and storage of used isotopes, or some part of that process, may take place in a separate area, and stress induction in the gamma camera room. This arrangement, if acceptable, may enable space savings.

Technician's office

7.71 As described in HBN 40: 'Staff areas' Vol. 3.

Cleaner's room

7.72 As described in HBN 40: 'Staff areas' Vol 3.

Functional relationships

7.73 The cardiac isotope scanning department should:

- provide ready access for patients from the main entrance and car parking areas, including disabled parking;
- provide good access for isotope delivery and removal of radio contaminated waste;
- ideally be close to or contiguous with the cardiac non-invasive investigation unit.

Special features

7.74 Radiological protection will be required in this area, in accordance with the advice of the radiological protection officer.

Cardiac catheter and electrophysiology laboratories

General

7.75 These laboratories are Category 3.

Functions

7.76 The laboratories should provide an efficient and safe service for patients, normally adults, who require any of the range of procedures undertaken in the department, patients will attend on a selective basis, after other investigations have been carried out, and as a result of prior consultation, except where patients have been referred to the department as an emergency.

7.77 There should be a suite of major procedure rooms utilising X-rays for a specialised range of cardiac investigations and treatments: implantation of pacemakers; electrophysiology measurement under fluoroscopy control; and other procedures for the diagnosis and treatment of diseases of the heart and associated vessels.

7.78 They should accommodate facilities for clinical teaching and research.

Biplanar laboratory

Post-procedure patient care area

Components

Entrance/waiting area

7.79 Sub-wait and sub-reception facilities, in addition to the main facilities provided in the day case unit, (see paragraph 7.28), and patient WCs and changing facilities, including facilities for the disabled, should be provided.

Catheter laboratories

Services

7.80 Each laboratory must be capable of undertaking a series of procedures. A minimum of two of these laboratories should be equipped with biplanar digital angiography machines, and there should be in addition at least one laboratory equipped with single-plane angiography equipment. Each laboratory requires a ceiling mounted and optionally moveable pendant for anaesthetic services and a ceiling mounted investigation lamp. Medical services should be provided from ceiling or wall-mounted outlets and should comprise medical oxygen, nitrous oxide, compressed air (at 7 bar and 4 bar pressure) and suction. Alternatively, a pendant solution to medical gases provision may be preferred. Anaesthetic gas scavenging should also be provided. Environmental services, finishes and fittings to all laboratories should be to minor operating department standard.

Dimensions

7.81 The laboratory must be large enough to accommodate a minimum of six team members plus the patient, and the major items of equipment listed below. The minimum size should be approximately 40m^2, with minimum critical dimensions of approximately 7.5m x 5.5m, larger in the case of a biplanar lab to accommodate the additional C-arm and because of the additional numbers of persons present at some of the procedures carried out in these laboratories. Designers should be aware that critical area and dimensions can vary according to the needs of a variety of operational and equipment options, and it is therefore important to obtain information on client preferences and the selected manufacturer's equipment before designing the room in detail.

Equipment

7.82 A major item is a multi-angular isocentric X-ray digital single or biplanar angiographic system. Most units currently available are floor mounted, but ceiling mounted systems are available. The installation will commonly incorporate a ceiling-suspended transparent leaded panel to give an element of radiological protection while allowing the cardiologist an acceptable view of the patient. Some manufacturers offer a combination of floor mounted equipment with ceiling mounted C-arm and/or couch assemblies. Where ceiling mounted or composite systems are to be installed, some additional reinforcement of supporting structures may be required, this is normally in the form of a unistrut. Floor mounted sub-components of the system are normally bolted through the floor structure or are otherwise securely fixed to it by rag bolts or other secure

heavy duty fixing devices, capable of retaining a moving mass weighing up to three metric tons with high residual torque.

7.83 An integrated or closely associated variable height patient couch is another major item. This must be capable of multi-directional movement and operating in conjunction with an isocentre positioned at or near the patient's heart. Exceptionally, tilting along the patient's long axis is required, and local discussion of this issue is advised.

7.84 Two to four ceiling mounted monitors are required. These display real time and digitally recorded angiographic images, with optional additional monitors displaying physiological data. There is a move to flat-panel displays, which will have the effect of reducing suspension and other engineering requirements. It should be noted that very occasionally trolley mounted monitors are encountered, and that although these have now been almost universally superseded by the ceiling mounted versions, they may have something to offer in the resolution of the couch-to-control-room relationship issues discussed later in this Section (see paragraphs 7.93–7.97).

7.85 Power injection facilities for contrast media are required. These are usually trolley mounted, but there is also a ceiling suspension option available.

7.86 An anaesthetic trolley and resuscitation equipment are required, as well as a minor procedures trolley.

7.87 A worktop with a wall mounted cupboard over and under, open shelves should not be used for hygiene reasons, wall or bench mounted warming cabinet for preparation of contrast media, wall mounted drugs cupboard and double X-ray viewer and wall mounted or floor standing catheter rack are required.

7.88 A leaded apron rack is required, located at the entrance to the room, preferably outside the controlled area, see below. The weight of such racks is considerable and may require additional reinforcement in the supporting floor structure.

Electrophysiology laboratories

7.89 At least one biplanar laboratory should be designed to undertake electrophysiological studies. This should be large enough to accommodate necessary equipment and a minimum of eight team members plus the patient. The main space-consuming items of equipment that are additional to the normal requirements are:

- two additional overhead monitors; and
- a desk-mounted physiological monitoring system and display.

7.90 There is a strong clinical preference for these to be located in the laboratory although other considerations, mainly radiation safety considerations, would suggest the adjacent control room to be a safer location. The problem is to

combine the safety benefits of a screened environment with the clinical requirement for immediate contact between those undertaking and those monitoring the procedure. To date, this problem has not been solved satisfactorily.

Control areas

7.91 Each laboratory should be served by an X-ray system control area, which conventionally is provided en-suite, but in a separate compartment, radiation protected and having good visual and voice contact with the laboratory. This arrangement is usually preferred on ergonomic and safety grounds. Exceptionally, and according to client choice, the angiography room has an open-LAN with no separate control area and with all people present wearing radiation protection clothing. This latter arrangement is unlikely to be a good option for NHSScotland because of the numbers of visiting consultants, usually surgeons, who may need to be present, and also because of the requirement for teaching in tertiary centres, but it is seen as having some positive benefits where the numbers of persons present is smaller, for example, in the private sector.

7.92 According to client choice, control areas may be provided separately for each laboratory, or shared between pairs of laboratories; in the latter case, the area must be large enough to enable two teams with their monitoring equipment to operate independently and maintain unimpeded access to the laboratory served. S pace must also be available for surgeons and visiting specialists to observe procedures in a radiologically safe environment. (See Figures 1 - 4 for examples of laboratory layouts.)

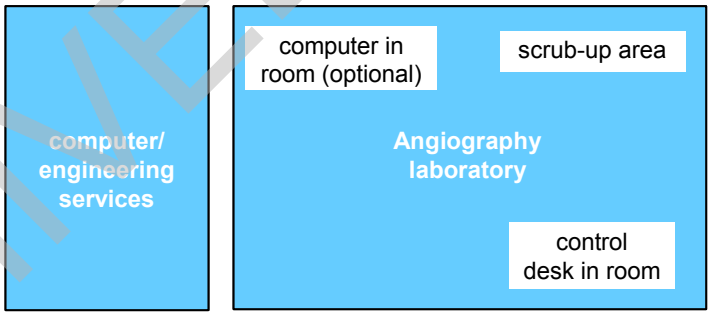


Figure 1: **Angiography suite 1: minimum viable unit**

Couch-to-control-room relationship issues

7.93 A problem that equipment manufacturers and facilities designers have not yet overcome is the positional relationship of the patient couch to the procedure-viewing panel in the control room. It arises from what are potentially conflicting requirements for access to and observation of the patient by the different members of the team, some of whom are stationed in the control room, and who are, under present regulations, jointly responsible for the safety of the patient while the examination is being undertaken. This conflict is normally resolved by acceptance of an element of compromise, but the challenge of developing a solution that is entirely satisfactory on all relevant counts remains.

The main issues and constraints that need to be addressed, largely centring around or impacting upon the orientation of the patient couch, are as follows.

7.94 The cardiologist undertaking the examination or procedure must have a clear and unobstructed view of in-room ceiling or trolley-mounted monitors. He/she will be left or right handed and therefore, in order to operate the equipment, introduce and manipulate the catheter into position and inject the contrast media in an ergonomically comfortable manner, will need to stand on either the right or left hand side of the couch adjacent to the approximate isocentre. From the point of view of the operator, an arrangement whereby the couch is at right angles to the control room viewing window, thus presenting an identical view of the patient along the long (cranial–caudal) axis of the body, would seem the best option, since it is not affected by the side on which the cardiologist stands.

7.95 Observers outside the control room must have a clear view of the patient in order to discharge the duty of care referred to above. It is argued that this cannot be properly done if only the feet of the patient are visible, as would be the case if the couch were placed at right angles to the control room. An arrangement whereby the couch is placed parallel to the control room viewing window, with the in-room team located on its far side, would facilitate very much better observation, but would significantly disadvantage a left handed cardiologist, who, under that arrangement, would prefer to stand on the near side of the couch where he/she would obscure the view of the patient from the control room.

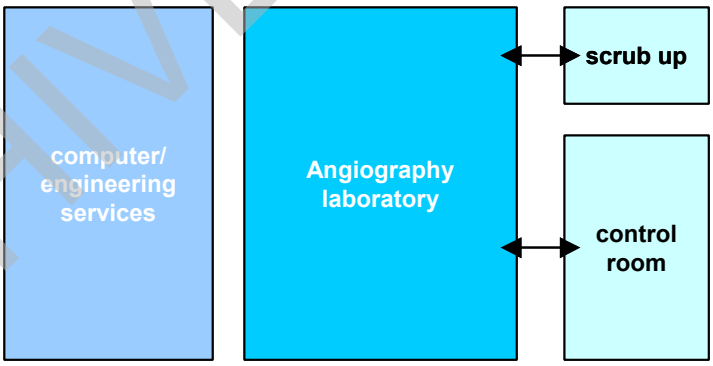


Figure 2: **Angiography suite 2: conventional arrangement**

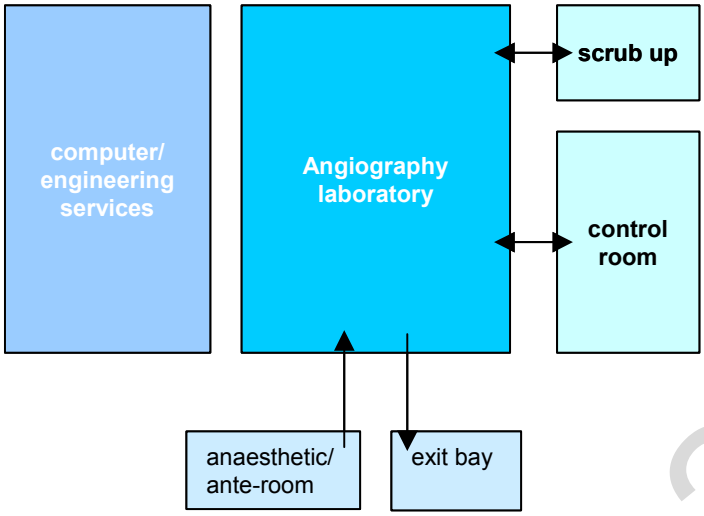


Figure 3: **Angiography suite 3: enhanced arrangement**

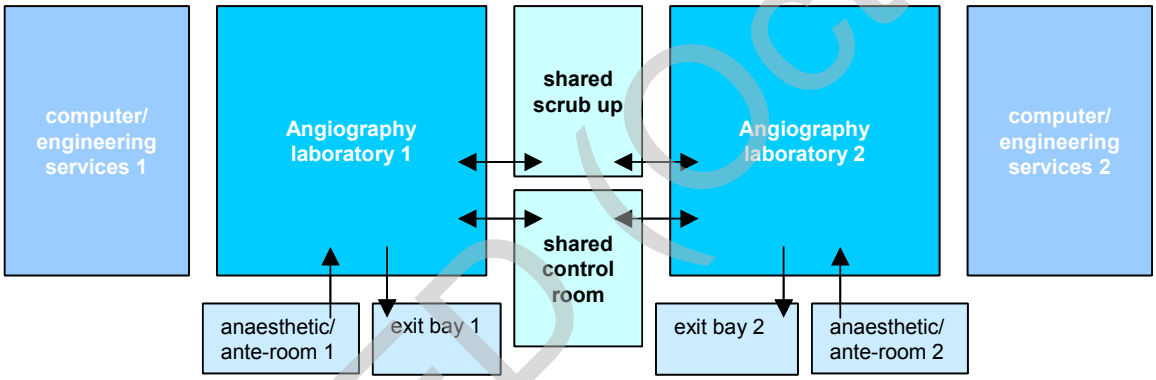


Figure 4: **Angiography suite 4: double angiography room arrangement**

7.96 An arrangement is needed that allows sound patient care to be undertaken in an area that is dominated by large items of equipment, some of which move during the course of the examination/procedure. This includes direct monitoring of the patient by a nurse stationed near the patient's head, and easy transfer of the patient onto and off the examination couch.

7.97 An arrangement is needed that works effectively within the engineering and other physical constraints imposed by the design of the equipment and the possible conflict between the operating space requirements of the large number of moveable ceiling and floor-mounted items of equipment that are located in these rooms.

Additional clinical space

7.98 Client requirements for additional clinical space adjacent to the laboratory may vary. For example, separate anaesthetic rooms and/or exit recovery bays are likely to be requested. Design teams should be aware of the requirement to design angiography facilities in full compliance with the requirements for minor operating suites; this will have an impact upon their layout as well as increasing the scale and complexity of the facility as a whole.

Preparation room/CSSD store

7.99 Each laboratory should be served by a combined preparation room/CSSD-only store; these may be shared as appropriate. SHPN 26: 'Operating Department', provides information on the layout and servicing of these rooms. These rooms must NOT be used as general storage facilities.

Scrub-up and sterile gowning areas

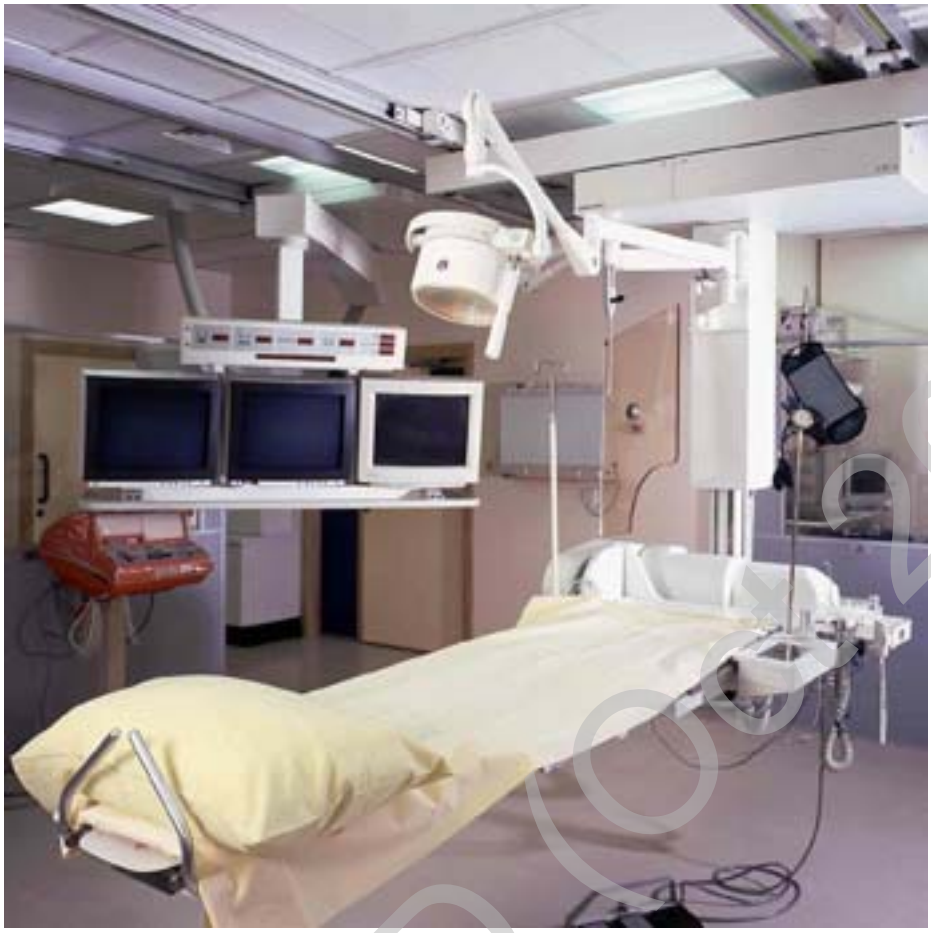
7.100 These should be provided for each laboratory, preferably in an adjacent communicating space, although some clients express a preference for the scrub-up area to be provided within the laboratory. In this case, the facility must be planned to provide sufficient space to prevent environmental contamination and recontamination of personnel.

X-ray imaging generator and imaging computer equipment

7.101 Accommodation is required for a dedicated X-ray imaging generator and imaging computer equipment serving each laboratory. In most cases, the preferred location for all of this equipment is an adjacent room or area accessed from within the laboratory by sound-attenuating radiation-protected doors or, preferably, removable panels. The presence of high-tension electricity, and the need for radiation protection for persons working in the room when the communicating door to the machine room from the laboratory is open, should be noted. The practice of providing access to this room from outside the laboratory is positively discouraged on safety and maintenance-efficiency grounds.

Surgical storage facilities

7.102 Facilities are required for the safe storage of used surgical instruments and 'hot-lock' trolleys used in the angiography laboratory prior to dispatch to a central facility for bio-decontamination and re-processing. It is not normally necessary to have to provide trolley storage for more than a single session of, say, 5–6 procedures. Local decontamination of used instruments is proscribed under new decontamination guidance, and these items must be returned to the SSU for bio-decontamination and recycling.



Angiography Room with monitors and examination light. The control room is in the background

Patient care area

7.103 A patient care area is required for approximately three pre and six post-procedure patients, depending on the projected throughput of the laboratories. Medical services, comprising medical oxygen, compressed air at 4 bar and 7 bar pressure, and suction, will be provided at each bed head from wall mounted outlets. Anaesthetic gas scavenging must also be provided. The layout of the patient care facilities should allow good bed access and patient monitoring. In some hospitals, it will be policy to allow relatives access to this area.

7.104 Associated with the patient care area will be:

- a dedicated staff base; with hand washing facilities, which must be provided in each clinical area;
- clean utility and dirty utility rooms;
- controlled drug storage;
- a disabled patient's WC.

Staff changing facilities

7.105 Staff changing facilities with showers/WCs are required. All staff working in clinical areas and visitors will wear appropriate theatre clothing, and facilities for the storage of these garments must be provided and conveniently located. The use of remotely located central changing facilities for this function is not recommended.

Changing sequence and route

7.106 All staff working in the angiography laboratory will follow a clearly defined changing sequence and route into the laboratory:

- personal clothes > greens > blues > lead apron/protection.

7.107 This sequence will determine the staff route into the angiography laboratory, and therefore the positional relationship between the physical spaces needed to accommodate it, that is:

- general access zone corridor > changing room > restricted access zone corridor > lead apron local storage (outside or adjacent the entrance to the angiography laboratory) > angiography laboratory.

7.108 In the case of those who need to be scrubbed up and gowned for the procedure, and only those persons, the sequence is modified to include the scrubbing and gowning sequence, that is:

- clothes > greens > blues > lead apron/protection > scrub > sterile gown

and the staff route modified thus:

- general access zone corridor > changing room > restricted access zone corridor > lead apron local storage, outside or adjacent to the entrance to the scrub room > scrub/sterile gowning room > angiography laboratory.

Laser imager printing room

7.109 This room is required to accommodate a laser imager and processor and film storage. Increasingly, modern laser printers use a dry process and do not require a docked or associated wet film processor. Some centres do not use a hard copy and may instead employ electronic image network communication, viewing and archive storage, and will often transfer images using CD-ROM. Electronic imaging will require a suitable computer room and associated facilities which may supplement or replace laser imaging.

Image archive facilities

7.110 An image archive workstation, review room and image archive storage are required. The review room should accommodate approximately four

workstations and about eight staff, and the image archive store about 50,000 CDs, if each CD holds a single patient record.

7.111 It should be noted that cine film imaging in cardiology is now virtually obsolete, but legacy film reading using a self-contained projector will still be necessary in most centres.

Staff offices

7.112 Offices for the superintendent radiographer, sister or senior nurse, senior technician and manager/supervisor are required.

Central departmental store and linen store

7.113 A central bay must also be provided for storage of lead-protective devices, including lead rubber aprons, lead glasses, thyroid protectors and dosimeters. As some of these items are very heavy, local reinforcement to supporting structures may be necessary. Storage of these items within the laboratory is discouraged, since it implies that unprotected persons will have to enter the room to obtain them, which might be hazardous or disruptive.

Catering facilities

7.114 Simple local catering facilities will be required.

Cleaners' rooms

7.115 Two cleaners' rooms should be provided, one for general use and one for laboratory use.

Functional Relationships

7.116 The location of catheter laboratories close to, ideally contiguous with and directly connected to, cardiothoracic operating theatres is increasingly seen as an essential measure to advance patient safety in the event that surgical intervention becomes necessary. In addition, the laboratories must, for reasons of patient safety, be close to and have simple and direct access to:

- the cardiac day case unit;
- the CCU; and
- the intensive and intermediate care units.

7.117 There must be good and direct access to and from:

- the centre/hospital main entrance;
- the A&E department or ambulance drop-off point; and
- cardiology and cardiothoracic inpatient accommodation.

Special features

Radiation

7.118 The design of the department must comply with the Ionising Radiation Regulations and the Health and Safety at Work Act. The angiography laboratory will be a 'controlled area' as defined in those regulations and all defining structures, including floors and ceilings, must be radiation-protected. The choice of construction materials for floors, ceilings and walls must be agreed with the radiation protection advisor, who must also be consulted on overall radiation protection standards, including aspects of design and room layout.

7.119 Controlled areas, and equipment rooms if so designated, may be categorised as 'supervised areas', and must also be protected, although to a lower level. Again, the choice of construction materials for floors, ceilings and walls must be agreed with the radiation protection advisor. In some cases, the equipment room is included in the controlled area, in which case the stipulations in paragraph 7.118 apply.

7.120 Non-controlled public access areas must be shielded to allow only very low radiation exposure arising from the use of angiographic systems. The limits of permitted exposure are controlled by legislation as interpreted and determined locally by the radiation protection advisor.

7.121 Doors into the angiography room must be radiation-shielded, and must open in such a way as to protect those entering. This aspect of design will be an important part of the consultation with the radiation protection advisor. There must be 'controlled area' and 'X-ray on' warning lights adjacent to the door, connected to the X-ray set power supply and generator.

7.122 Design teams are reminded of the requirement that all catheter laboratories must be designed and fitted out in full compliance with operating theatre standards, see SHPN 26: 'Operating department'.

Light fittings

7.123 Light fittings must be located with reference to the positioning of the X-ray table and tube stand. Very carefully designed locally variable light level control must be provided in the angiography laboratory (fluoroscopic imaging perception can be adversely affected by poor lighting design, which may, for example, fail to eliminate reflection on monitoring screens or allow local dimming).

7.124 Colour-corrected lighting will be provided in all patient areas and in the image review room workstation. Level control and the avoidance of reflections in monitors in the image review room workstation are essential.

Air conditioning

7.125 Full air conditioning and macro-filtration, heating and cooling should be incorporated into the catheter laboratory suites and recovery area, manually controlled from within each area. Separate air conditioning and humidity controls should be provided for the computer/generator rooms.

Power supply

7.126 Emergency lighting and power should be provided in the catheter laboratories, recovery area and computer/generator rooms.

7.127 The possibility of limited operation of the angiography imaging system in order to permit the removal of a catheter under X-ray control should be expressly considered, and discussed with the hospital's and system manufacturer's engineers.

7.128 Protection of computer equipment by the provisions of an uninterrupted power supply (UPS) will provide safety and operational advantages.

Other special features

7.129 Clocks with sweep second-hands will be required in each laboratory and anaesthetic room (if provided).

7.130 The requirement for data links/LANs in this department will be extensive, including possible telemedicine links with, for example, A&E services and the CCU. An intercom system will be required throughout the department.

7.131 Furniture, fittings and fixtures must be easily cleanable.

Operating department: minor cardiac procedures, including pacemaker insertions

General

7.132 This department is Category 3.

Functions

7.133 These are:

- to provide a safe environment in which to carry out relatively minor procedures where the risk of infection is low and the period of immediate recovery is short;
- to provide an appropriate alternative location to the angiography laboratory for the safe insertion and/or replacement of temporary, and possibly permanent, pacemakers;

- to provide facilities that can be used flexibly, including, where planning and locational factors make this feasible and desirable, joint use with other clinical specialities, for example, neurosciences.

Components

Entrance/waiting area

7.134 Simple reception facilities should be provided for patients, most of whom will be ambulant, but some of whom will arrive in wheelchairs or on trolleys. Depending on the location of the procedures room, this function may be included within the reception facilities of a larger unit.

Procedures room

7.135 A procedures room with a minimum area of approximately 28m^2 should be provided to accommodate:

- a moveable patient couch and mobile single C-arm X-ray imaging system, controls and trolley-mounted monitor, low-powered ceiling-mounted operating lamp and single surgical pendant and a small surgical procedures trolley. All round access to the patient on the couch is essential;
- facilities for clinical hand washing: some local teams will require scrub-up facilities, which may be located adjacent to or in a corner of the procedures room, and must be of sufficient area to ensure that there is no environmental contamination or recontamination of personnel;
- medical gases, including air, oxygen medical suction/vacuum. General anaesthesia will not be given at this level. Mechanical ventilation to minor operating theatre standards using coarse-filtered air is required, but micropore filters and accurate air-flow control is not considered essential;
- facilities for note-taking, etc, the increasing use of laptop computers should be noted;
- clinical quality colour-rendering light sources, and walls, ceilings and floors of suitable colour and reflectancies.

7.136 Wall mounted fixtures and fittings where provided should have ‘easy clean’, non dust collecting surfaces. It is advised, however, that storage for all supplies should be in an associated clean area and not in the procedures room, see below.

Separate recovery area

7.137 A separate recovery area is required to accommodate up to two patients on trolleys, with medical gases, including medical air and oxygen suction/vacuum. Depending on the location of the procedures room, this function may be provided within the recovery facilities of a larger unit.

Storage facilities

7.138 Local clean storage facilities are required to include facilities for drugs storage and laying up small surgical trolleys in a properly ventilated area. Separate facilities are needed for the short-term storage of contaminated instruments and hot-lock trolleys prior to transfer to a central facility for bio-decontamination.

Special requirements

7.139 General advice on the broadly similar concept of a 'treatment area' is provided in HBN 40: 'Treatment areas', Vol. 2. Design teams should be aware that this advice is currently being revised.

7.140 Consultation with the radiation protection advisor will be necessary to determine whether and to what extent radiation protection may be required in the procedures room.

7.141 High-density block-work construction and light-leaded screening of doors may be necessary, and this may have structural implications.

Functional relationships

7.142 There are a number of options for the location of these facilities, and the preferred location will be highly dependent on local opportunities and planning constraints. They should be:

- close to the OPD, or other facilities used in the provision of general cardiac outpatient care, for example, the day care unit;
- part of an operating theatre complex, perhaps located towards the periphery of the 'controlled access' zone, see below, but in a relatively patient accessible location;
- easily accessible to cardiac inpatient wards.

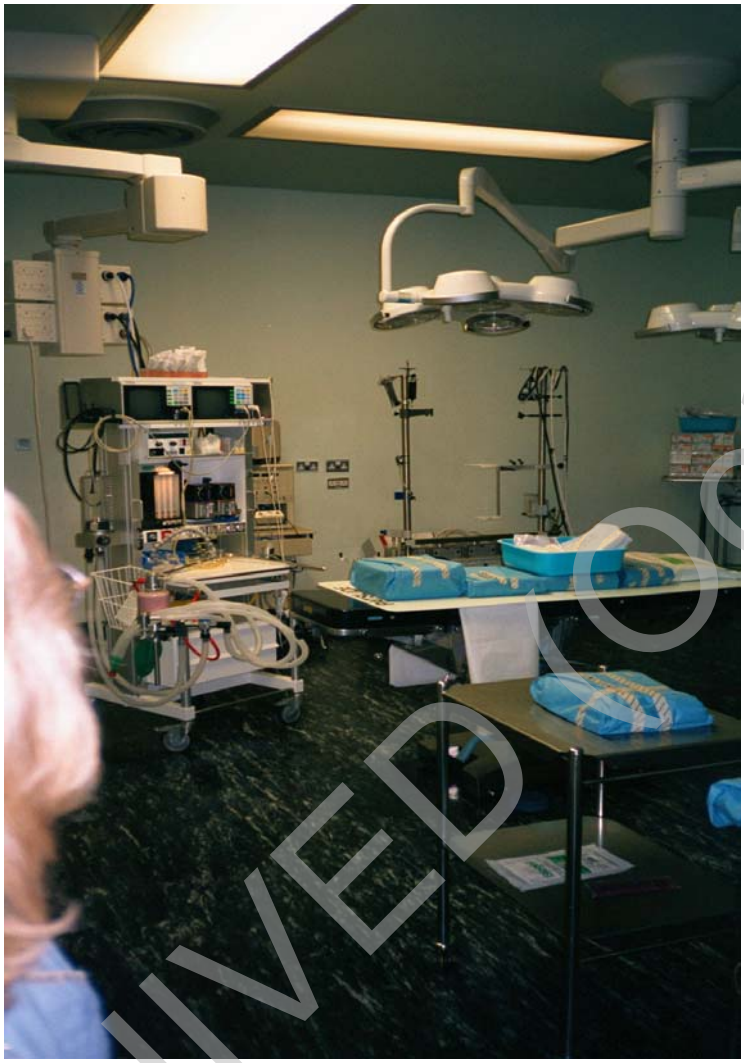
Operating department: general cardiac surgery

General

7.143 The assignment of Category 3 status to the whole of the operating theatre suite assumes that the theatre component of the cardiology/cardiothoracic centre is located wholly within the centre and is an entirely self-contained unit. Although this arrangement is already found in a few highly specialised centres, and is an option anticipated to be increasingly explored as existing centres upgrade to deliver new standards or where new centres are being built, this approach is not obligatory in order to achieve progress in this area.

7.144 In other centres, cardiothoracic theatres have developed as an integral part of an existing general theatre complex, or have been added to form an annex to it, in which case there is often substantial sharing of support facilities. Where this is the case, and where the arrangement works satisfactorily, it might be

counterproductive or prohibitively costly to create a totally separate cardiothoracic theatre complex if no other substantial benefits accrue. In such cases, only the theatre itself, and some of the specialist rooms associated with it, are Category 3. The remainder of the complex will be Category 1 or 2.



High category specialised operating theatre

7.145 The following recommendations should enable design teams, in consultation with the user client, to identify any modifications required to be made to existing theatre facilities or to design a comprehensive and fully integrated 'stand-alone' cardiothoracic surgery facility. Guidance on the detailed requirements of operating facilities can be found in SHPN 26: 'Operating Department'.

Functions

7.146 The design of operating theatre and supporting clinical facilities, including specialist anaesthetic and clinical perfusion services, must allow Trusts to undertake anticipated numbers of procedures. In addition, it must allow for expansion so that new activities and research can be undertaken and activity increased if required.

7.147 The theatre must provide a safe operating environment for adult inpatients to undergo simple procedures, closed and open-heart cardiac and thoracic surgery and, in a small number of nominated centres only, heart and heart/lung transplants. Guidance on the provision of cardiac operating facilities for children, only likely to occur in a small number of highly specialised centres, is not included in this document.

7.148 The theatre must provide an anaesthetic service.

7.149 The theatre must provide facilities for clinical teaching and research.

7.150 It is assumed that a major tertiary centre would require a minimum of four operating theatres to fulfil all the functions listed above and this has formed the basis upon which this schedule of requirements has been calculated. It should also be noted that the levels of theatre activity generated, as a result of proposed new standards, are likely to rise. As expansion of operating theatre facilities is a highly disruptive process, often requiring existing theatres to close for substantial periods, planning teams should consider what provision can and should be made for expansion of capacity. This could include provision for extended hours of operation, and how such provision will affect the overall shape of their proposals.

7.151 The operating department will be divided into three zones as follows:

- a general access zone, to which anyone who enters the department is admitted;
- a restricted access zone, to which only those whose business requires that they should enter those parts of the department adjacent to the 'operating zone' may enter;
- an operating zone; the theatres and rooms directly associated with the procedures undertaken in them.

Components of the general access zone

Entrance/waiting area

7.152 Patient reception and transfer facilities are required. Patient transfer policy is the major factor determining the size of this area.

7.153 A staff control base and/or theatre supervisor's office and porters' base will be required.

7.154 Specific requirements for bed/trolley parking and damp dusting area, clean and dirty linen holding areas and for a 4–5 bed/trolley holding bay for post-transfer/pre-anaesthetic patients should be agreed with the client.

7.155 The design of the entrance area should take into account the hospital's operational policies in relation to security, control of infection, supplies and disposal.

Departmental reception office

7.156 This should include a reception desk and waiting space for up to four admissions/department visitors and offices for department management and administrative staff.

Disposal bay

7.157 There must be access from both the general and the restricted access zones.

Components of the restricted access zone

Changing areas

7.158 Separate male and female staff pass-through changing areas are required and should be entered from the general access zone and exit to a clean corridor which gives access to the operating zone. These areas should include WCs, showers and hand washing facilities in a separate, lobbied and mechanically ventilated 'wet' area. They should also include secure rack storage for outdoor clothes, shelving or other storage facilities for theatre clothing, lockable staff clothes lockers, and separate mechanically ventilated clean and dirty boot storage and changing lobby. Changing rooms are to be sited so that no person may enter the restricted zone without first passing through them. If planning allows, it would be an advantage if these spaces could be shared with the cardiac ITU/ICU.

7.159 The changing sequence for staff working in the theatres is identical to that for staff working in the angiography laboratory (see paragraphs 7.106 – 7.108).

Recovery area

7.160 A four-bed recovery room with associated staff base and utilities are required for the post-operative care of patients undergoing standard procedures. Patients requiring intensive care, likely to be a substantial proportion of the total case-load, will go directly to the cardiac ITU/ICU.

Clean clinical sub-laboratory

7.161 A clean clinical sub-laboratory is required for blood gas analysis, electrolytes, etc. It should contain a blood fridge, this may be shared with the cardiac ITU/ICU.

Dedicated workshop

7.162 A dedicated workshop is required for the servicing of anaesthetic and intensive care machinery, this may be shared with the cardiac ITU/ICU.

Perfusion preparation room

7.163 A perfusion preparation room and workshop are required, including facilities for cleaning and storage of four perfusion (heart/lung) machines.

Dirty utility room

7.164 A dirty utility room is required with facilities for emptying suction bottles, cleaning equipment and materials, etc., and the short-term storage of used surgical trolleys.

Staff room

7.165 A staff room must be provided to accommodate 30–40 staff, and should include a beverage bay.

Seminar room

7.166 A seminar room, with CCTV link to theatre should be provided. This may be shared with the cardiac ITU/ICU.

Angiography viewing room

7.167 An angiography viewing room is required, equipped with cardiac capable imaging workstations connected to an archive store by a LAN.

Consultant's room

7.168 A consultant's room should be provided with facilities for dictating notes, etc.

Main sterile store

7.169 A main sterile store is required with facilities for reception, short-term storage and distribution of sterile packs, linen and other items to preparation rooms, etc. (Category 1), where cardiac theatres form a part of, or are annexed to, a larger general suite depending on local policy. This provision does not, however, replace the Category 3 en-suite preparation room that forms part of the operating zone described below in paragraphs 7.186 – 7.187.

Storage and maintenance facilities

7.170 Provision should be made for the storage and possible maintenance of mobile X-ray equipment, including dark rooms.

Cleaner's room

7.171 A cleaner's room should be provided.

Components of the operating zone

Anaesthetic rooms

7.172 Four anaesthetic rooms are required, one to be provided en-suite with each theatre, with a minimum area of 15m^2 and minimum dimensions of 3.6m x 4.2m. An area of 17m^2 is preferred (approximately 4.0m x 4.2m), especially where there is a possibility that induction of a patient is undertaken while another is still

in theatre. This allows an increase in the number of patients able to pass through the system during a session.

Equipment and services

7.173 The anaesthetic room is entered by double doors from the clean corridor, see below, and connects directly by double doors to the operating theatre. Patients will be brought to the anaesthetic room on a bed or trolley and will be transferred to theatre table or top and positioned for operation prior to or after induction. Clinical procedures, such as the setting up of intravenous infusions, may be instituted in the anaesthetic room, as well as the attachment of diathermy pads and monitoring equipment to the patient. High levels of room lighting are necessary for some, but not all, of these procedures. Each anaesthetic room should have pendant-fed piped medical gases, including medical oxygen, nitrous oxide and compressed air (4 bar pressure). Medical vacuum and gas scavenging systems should be provided. Hand washing facilities must be provided.

7.174 Other fixed and loose equipment will include worktop and separate writing space, drugs fridge, lockable drugs cupboard and other general storage cupboards.

Scrub-up/sterile gowning room

7.175 One scrub-up/sterile gowning room should be provided en-suite with each theatre, with a minimum area of 10.2m^2 and minimum dimensions of 4.25m x 2.4m, entered by a single-leaf door from clean corridor and connecting directly into the operating theatre. The design of this space should minimise the possibility of accidental contact during scrubbing and gowning. Fixed equipment is likely to include scrub troughs with wrist action or automatic water outlets, hands free soap dispensers, nailbrush and glove dispensers and shelves for storage of gown packs. The main item of movable equipment will be a gowning trolley. The door into theatre should have an elbow-operated handle or alternatively be of flexible rubber to allow scrubbed members of the surgical team into the operating theatre.

Operating theatres

7.176 Four operating theatres are require, see paragraph 7.150 for an explanation of choice of functional unit. Comprehensive guidance on the design of operating rooms generally is provided in SHPN 26 ‘Operating Department’. This guidance emphasises certain basic aspects of provision that might impact upon the planning of such rooms in the context of a cardiac/cardiothoracic surgery programme. The further and more detailed implications for the design of operating theatres in support of the organ transplant programme, which occurs only in designated centres in the UK at the present time, is not pursued in this current guidance. Cardiac facilities for children will be covered in SHPN 28; ‘Facilities for Cardiac Services: Part 2’, to be published in the future.

Dimensions

7.177 All theatres in which cardiac work is carried out will be a minimum area of 63m^2, broadly rectangular and with a minimum dimension in any single direction of 7m. They will be grouped in pairs, each capable of supporting the broad range of cardiac and cardiothoracic work undertaken in the centre. When coronary bypass operations are being undertaken, it is necessary to accommodate two surgical teams with their support apparatus working on the patient simultaneously, and it is this requirement that has the greatest significance for the design and layout of the room.

Occupancy

7.178 Occupancy of the theatre during an operation will normally comprise:

- a lead and support surgeon with a scrubbed nurse to support, plus a non-scrubbed running nurse; and
- an anaesthetist and anaesthetist's assistant.

7.179 When a bypass operation is being undertaken, that occupancy will be increased by:

- a second surgical team, comprising lead and support surgeon, scrubbed nurse and running nurse and perfusionist;
- an operating department assistant to operate the heart bypass machine.

Services and equipment

7.180 In centres where organ transplantation is undertaken, and following consultation with the user client on the operational and management issues involved, one of the pair may be designed and equipped, but not necessarily designated exclusively, for transplant work.

7.181 Cardiac theatres must be able to accommodate bulky equipment such as heart/lung bypass (perfusion) machines, mobile C-arm X-ray unit and monitors and an operating microscope.

7.182 Each theatre will accommodate a range of operating lamps, two service pendants (an option is to have a third, dedicated anaesthetic pendant located at the patient's head) and its own operating microscope. Lamps and service pendants are to be positioned so that during bypass operations the surgical team operating on the patient's thorax and heart, normally from the patient's right side, and on the leg, normally from the patient's left, has exclusive access to and control over its own set.

7.183 A small bay equipped with a shelf for surgeons, and others, wishing to examine specimens should be provided.

7.184 Theatres will be provided with medical oxygen, nitrous oxide and compressed air (at 7 bar and 4 bar pressure). Local anaesthetic gas scavenging is essential. A minimum of one, possibly all, theatres will have colour CCTV incorporated into the theatre lamp system and linked to a seminar room, for teaching purposes. Facilities for patient cooling, during low temperature procedures must also be provided.

7.185 Two exit bays of approximately 23m^2, each shared between two theatres, will be large enough to accommodate the parking of two beds or trolleys awaiting the return of patients from theatre. They usually contain a local equipment storage cupboard.

Preparation room

7.186 Each theatre will have en-suite a specially ventilated preparation room with a minimum area of 12m^2 for storage of sterile packs from CSSD and laying up of theatre trolleys. This room should be separately entered from a corridor within the restricted access zone, and connected directly with the theatre through a doorway that is wide enough to permit the passage of a prepared trolley without compromising sterility.

7.187 The room must be large enough to accommodate the preparation of a sterile trolley by a scrub nurse and assistant, together with storage of sterile trolleys laid for the next case. However, it should be noted that in order to comply with control of infection procedures, no more than the instruments for one additional case should be prepared in advance. Layout space for instrument trays, etc., together with other items such as warming cabinets, etc., should be standard to each preparation room. There should, in addition, be an area reserved for items particular to the theatre that they serve.

Dirty utility room

7.188 A specially ventilated dirty utility room of 8m^2 minimum area is required for the disposal of liquid wastes and the bagging of contaminated and dirty materials generated during the course of an operation and awaiting collection, instruments must not be prewashed, which will be returned to CSSD for decontamination. This room should be entered from a corridor within the restricted access zone, or from the exit bay, and adjacent but not connecting directly with the theatre. Surgeons wishing to examine specimens will often do so in this space.

7.189 Fixed equipment will include a slop-hopper and drainer, shelves for the storage of disposal bags and specimen containers, hook clips for vertical storage of cleaning equipment, etc. Facilities for clinical hand washing should also be provided.

Mobile Image Intensifier Storage Bay

Cleaner's room

7.190 A cleaner's room should be provided.

Special features

7.191 These are as follows:

- traffic flow should avoid 'dirty' areas except for disposal or recycling;
- all special ventilation and air conditioning provision should be in accordance with current regulations and take account of current guidance issued by NHSScotland Property and Environment Forum and other regulatory bodies;
- where diathermy equipment is to be used, special attention should be paid to special protection requirements and surface finishes;

- an electrical power supply should provide back-up power generation and a UPS;
- lighting should be colour corrected in all patient areas. Operating theatre luminaries should be shadowless, and back-up mobile lamps should be provided;
- an intercom system should link the staff base, staff rest room, recovery, all theatres, blood gas analysis laboratory and ITU. Telemedicine links between A&E services, operating theatres, CCU and cardiac ITU allowing ECGs and echocardiograms to be viewed in each location would provide substantial benefits and should be considered.

Functional relationships

7.192 It is essential that the operating zone:

- is close to the cardiac ITU/ICU (fundamental relationship);
- provides close, simple access to and from the CCU, intermediate care unit, cardiothoracic and cardiac inpatient wards, ideally located on the same floor, if not, with immediately accessible lift connection;
- is close to the anaesthetic department and offices of consultant surgeons;
- has good connections with the CSSD.

7.193 It is desirable that changing rooms, staff catering facilities and rest rooms are sited within or adjacent the centre to avoid staff having to change out of theatre garb to go outside the centre.

Intensive therapy unit

General

7.194 The assignment of Category 3 status to the ITU assumes that it is a unit wholly devoted to the care of cardiac patients. Not all centres will have intensive therapy facilities provided in this form, particularly where the cardiac operating theatres form a part of or annex to a general operating theatre complex (see discussion in paragraph 7.144). The intensive care of cardiac patients may have developed historically in the hospital's general ITU, classified for the purposes of this guidance as Category 1 or 2. Where such an arrangement exists, local review should be undertaken to determine its current adequacy and relevance. A majority within the cardiac community would now expect that in new or substantially upgraded centres the care of cardiac patients would take place within a dedicated unit, but such an arrangement is not essential in order to achieve progress in this area.

7.195 The cardiac ITU forms a part of a group of critical and intermediate care services and facilities that includes, in addition to the unit itself, immediate

postoperative recovery, intermediate care, coronary care and care on the general cardiac medical and surgical wards. The separation of these functions and their allocation to separate areas within the hospital/centre makes it possible to achieve a smooth gradient of care that is appropriate to the patient's clinical and nursing dependency, while at the same time deploying resources in such a way as to level by compression the effective risk to the patient at each step of the way.

Size of units

7.196 The size of the unit and the ratio of intensive care places to other inpatient resources is very much influenced by throughput and case mix, and is likely to vary within fairly elastic limits from centre to centre. Use of conventional planning formulae to determine levels of provision should therefore be avoided where possible in favour of a more rigorous approach that takes local factors into account. Generally, however, most centres will have ITUs with about 12–15 beds.

Clustering

7.197 There is an observable and increasing tendency to 'cluster' high and intermediate intensity nursing facilities, including non cardiac related high and intermediate intensity facilities, into critical care complexes in close physical relationship with high-risk interventional and other services requiring similar support. The aim of such a cluster in relation to cardiac patients is to provide graded levels of care from intervention and immediate, closely observed recovery, through intensive, multi-system support (ITU) to single system support (ICU) and CCU.

7.198 Clustering has been achieved successfully where careful analysis of the costs and benefits of total separation and unique location, as against the risks and benefits of a degree of integration and sharing of core facilities on a zonal basis, has been carried out on a multi-disciplinary basis. In some centres outside the UK, solutions have been developed in which all patients requiring intensive therapy and care are nursed together in a single, very large unit. Generally, clinical and nursing opinion in this country does not go so far as to embrace this solution, but there is interest in clustering arrangements that encourage the flexible use of space by different clinical specialities or patient groups through careful planning and design.

7.199 For the purposes of this guidance, a 'stand alone' facility is assumed, but reference to sharing is made where a clustered solution offers this option.

Functions

7.200 The ITU should provide a safe environment where patients can recover from cardiothoracic surgery in one facility. Some patients will require short term recovery and 12–24 hour specialist monitoring post-surgery, while others will require longer periods of care and monitoring, typically up to four days. The unit may also be required to accommodate patients awaiting surgery who have been

admitted as emergencies through the A&E department of the hospital, and others who have been transferred from other hospitals lacking appropriate facilities for the intensive care of cardiac patients.

7.201 It should provide facilities that can be used as flexibly as possible for patients with a wide range of dependencies requiring immediate and usually continuous access to life support and other facilities and/or services. This includes emergency interventions where transfer of the patient to an operating theatre, which must always be adjacent, is either impractical or undesirable for patient safety reasons.

7.202 It should provide an environment in which patients who are particularly vulnerable to infection can be nursed safely, including facilities for barrier and reverse barrier nursing.

7.203 Consistent with the demands of clinical practice and sound nursing techniques, other patients and visitors must be shielded from visually and aurally distressing activity, and the design of the unit should be such as to keep unavoidable stress levels to a practical minimum.

7.204 The unit should enable staff to develop a wide range of skills and provide facilities for teaching.

Components

Entrance/waiting area

7.205 A patient reception and transfer area is required, including a trolley bay. It may be shared with other units in a clustered solution.

Visitor waiting area

7.206 A visitor waiting area is required, with access to sanitary and beverage facilities, including provision for the disabled. The entrance to the department should be strictly controlled, with short visits allowed throughout the day. It may be shared with other units in a clustered solution.

Overnight visitor accommodation

7.207 See paragraphs 5.115 – 5.116.

Intensive Therapy Unit

Multi-bed bay

7.208 A multi-bed bay, typically 8–12 bed spaces, is required, each bed space being sufficiently large to allow all-round access to the patient, who will be nursed on a one-on-one basis, and to accommodate a wide range of ceiling, gantry or trolley mounted patient monitoring devices and life-support systems. In the case of an emergency, six to eight members of staff may be in attendance at any time at the patient's bedside. The design of the space must allow surgical and other interventions to be undertaken on an emergency basis when patients cannot be moved into a more appropriate location for practical or safety reasons, and this may involve bulky equipment and additional staff. The design of each individual bed space must ensure that staff working with the patient, and nurses and other staff working in the multi-bed bay or at the staff base, have a clear view of the patient and monitors and are able to carry out procedures safely with no hindrance from suspended equipment. Trailing wires should be eliminated or kept to a minimum where practicable.

7.209 Extra-nursing procedures that may be carried out at the patient's bedside include echocardiology scans, heart massage by a cardiac surgeon, insertion or replacement of temporary pacemakers using mobile C-arm image intensifiers

with associated control and monitor, and chest X-ray using mobile X-ray equipment and teaching. See Special features below for further discussion.

Single-bed rooms

7.210 A minimum of two single-bed rooms is required, at least one designed for full isolation with air lock. In most units, approximately 20–25% of total provision will be in single rooms. Equipment and layout considerations are generally similar to those for the multi-bed bays. There must be good visual contact between the occupant of the room, the staff working in it and those in the multi-bed area and in the staff base. This latter requirement is normally met by the provision of glazed partitions between the multi-bed area and/or the staff base.

Staff base

7.211 An associated staff base should be provided, with monitors linked to individual bed spaces and a clear and unobstructed view of multi-bed bays and, so far as is consistent with barrier nursing requirements, the single rooms. Resuscitation equipment should be kept near to the staff base, see also HBN 40: 'Staff areas' Vol. 3 for general requirements.

Clean utility room

7.212 A clean utility room is required that will accommodate a drugs cupboard, drugs fridge and lockable medicines cupboard, work surfaces and space for laying up procedures trolleys. Hand washing facilities must be provided. A minimum area of approximately 18m^2 should be provided, see also HBN 40: 'Treatment areas' Vol. 2 for general layout and requirements. Depending on location and local policy, this room may be shared with other units, for example, the CCU.

Dirty utility room

7.213 A dirty utility room is required that will accommodate facilities for bed-pan cleaning/disposal, urine testing, an enclosed sluice and space for short-term storage of used procedures trolleys and instruments prior to return to a central decontamination room for bio-decontamination and recycling. Hand washing facilities must be provided. A minimum area of about 15–16m^2 should be provided. This area may need to be increased if local policies on disposal services require more than very temporary provision for bagged disposal items, see also HBN 40: 'Treatment areas' Vol.2 for general layout and requirements. Depending on location and local policy, this room may be shared with other units, for example, the CCU.

Small sub-laboratory

7.214 A small sub-laboratory for blood gas and electrolyte analysis should be provided. It may be located in one of the operating theatres, which should be immediately adjacent, or shared with other units in a clustered solution. Hand washing facilities must be provided. A small refrigerator may be required for temporary holding of laboratory specimens prior to transfer to central laboratories.

Local storage facilities

7.215 Local storage facilities should be provided for disposables, fluids, hoists, special mattresses, bulk supplies and equipment. These facilities may be shared with other units in a clustered solution.

Pantry

7.216 A pantry for serving patient meals and beverages should be provided. It may be shared with other units, depending on location. Hand washing facilities must be provided.

Interview/counselling room

7.217 There should be access to an interview/counselling room, to accommodate up to five persons. It may be shared with other units in a clustered solution.

Staff rest room

7.218 A staff rest room with a beverage bay, should be provided, typically to accommodate 12–15 persons. It may be shared with other units in a clustered solution, but in this case total numbers to be accommodated would need to be re-calculated.

Administration offices

7.219 Offices for administration, medical and nursing staff are required. They may be shared with other units in a clustered solution.

Equipment workshop

7.220 An equipment workshop is required. It may be shared with the operating theatres, and with other units, in a clustered solution.

Seminar room

7.221 A seminar room should be provided. It may be shared with the operating theatres, and with other units, in a clustered solution.

Disposal room

7.222 A disposal room should be provided for the storage of clinical waste/laundry/hot-lock trolleys for used instruments awaiting disposal or collection.

Special features

7.223 These are as follows:

- each bed space should be at least 3m wide to allow for use of bulky equipment e.g. ventilators, balloon pumps, dialysis machines and special

airbeds, that is in regular use. Equipment and services should be gantry-/pendant-mounted. In addition, each bed head requires a minimum of four oxygen outlets, three suction outlets, three medical compressed air outlets and 12 double electrical socket outlets;

- mobile X-ray examination is a frequent procedure and power supply, equipment storage and maintenance and radiological protection for staff and patients are vital considerations that need to be discussed locally;
- each bed space should include a clinical hand-wash basin;
- bed spaces require easy surveillance from staff base, while affording visual privacy for patients as needed, using a curtain system or retractable screens in multi-bed areas;
- all rooms require natural daylight and, where possible, a view. Exceptionally, and depending on local circumstances, the requirement for the latter in the case of single rooms may be met if there is a reasonable level of 'borrowed' lighting available through a glazed partition from the multi-bed area;
- special attention must be paid to the infection control and control of environmental contamination requirements of isolation rooms;
- all patients require access to life-support equipment including ventilators, special multi-parameter monitoring, specialist beds, etc;
- an emergency power supply, both by generator(s) and UPS, is required;
- modern communications systems are required, to summon help, access data and share expertise.

Functional relationships

7.224 It is essential for the ITU to be close to, and ideally contiguous with, the cardiothoracic operating theatres to allow easy and rapid transfer from and back to theatre and rapid access to the unit by a cardiac surgeon in an emergency.

7.225 The ITU should be conveniently close to:

- the cardiothoracic ward (ideally on the same floor, to allow for rapid emergency transfer of very sick patients from the ward, otherwise by an immediate access lift);
- the CCU and intermediate care unit (see discussion of clustering in paragraphs 7.197–7.199);
- the anaesthetic department and offices of consultant surgeons.

7.226 It is desirable to have direct and easy access from the A&E department, if on-site, or from the ambulance dropping-off point if not.

Intermediate care unit

General

7.227 This unit is Category 3. Intermediate care units, or 'step-down' units as they are sometimes called, are rarely provided in total clinical isolation. Due to their relatively small size, the level of support required to make them genuinely self-sufficient is difficult to justify, particularly in the case of emergencies, or at night. Its most common association is with a cardiac inpatient unit and/or ITU, since its main purpose is to relieve pressure on both or either. If the latter, then it is sometimes incorporated into a larger cluster, where the opportunity to share core support services and facilities is very much enhanced.

7.228 For the purposes of this guidance, a 'stand-alone' facility is assumed, but reference is made to the possibility of clustered solutions (see discussion of clustering in paragraphs 7.197–7.199).

7.229 The number of beds provided within an intermediate care unit may vary with local policy and estimates of throughput. For the purposes of this guidance, a fairly standard unit of 6–8 beds has been assumed, although in some centres a larger unit may well be justified.

Functions

7.230 The intermediate care unit should provide a safe environment for patients who do not require the intensive multi-system support, continuous one-on-one close monitoring and emergency access provided in the ICU. These patients however do require continuous monitoring and single-system support that cannot be conveniently or economically provided on a standard, general cardiac ward.

7.231 It should provide an environment in which patients who are particularly vulnerable to infection can be nursed safely, including facilities for barrier and reverse barrier nursing.

7.232 It should enable staff to develop a wide range of skills and provide facilities for teaching.

Components

Entrance/waiting area

7.233 A patient reception and transfer area is required, including a trolley bay. It may be shared with other units in a clustered solution.

Visitor waiting area

7.234 A visitor waiting area is required, with access to sanitary and beverage facilities, including provision for the disabled. The entrance to the department will be

strictly controlled, with short visits allowed throughout the day. It may be shared with other units in a clustered solution.

Staff gowning area

7.235 Visitors will not generally be expected to change before entering the unit, but this may require confirmation at local level. This area may be shared with other units in a clustered solution, although an additional dedicated changing area is required within the barrier nursing area.

Multi-bed bay

7.236 The layout and equipping of this area is similar to that described under 'Intensive therapy unit' (see paragraph 7.208), except there is normally less equipment, fewer services and less staff to accommodate around the patient's bed. However, bulky resuscitation and monitoring equipment and additional staff and teaching need to be accommodated. Hand washing facilities must be provided.

Single-bed rooms

7.237 A minimum of two single-bed rooms is required, at least one designed for full isolation with air lock. In most units, approximately 20–25% of total provision will be in single-bed rooms. Hand washing facilities must be provided. The layout and equipping is similar to that described under ITU (see paragraph 7.210).

Entrance area for intermediate care single bedroom

Bed-head in intermediate care unit

Nurses base in intermediate care unit with centralised monitoring area

Staff base

7.238 An associated staff base should be provided, with monitors linked to individual bed spaces and a clear and unobstructed view of multi-bed bays and single rooms, so far as is consistent with their barrier nursing requirements. Hand washing facilities must be provided. Resuscitation equipment should be kept near to the staff base, see also HBN 40: 'Staff areas' Vol. 3 for general requirements.

Clean utility room

7.239 A clean utility room is required that will accommodate a drugs cupboard, drugs fridge, lockable medicines cupboard, work surfaces and space for laying up procedures trolleys. Hand washing facilities must be provided. A minimum area of approximately 18m^2 should be provided, see also HBN 40: 'Treatment areas' Vol. 2 for general layout and requirements. Depending on location and local policy, this room may be shared with other units, for example, the ITU and/or CCU.

Dirty utility room

7.240 A dirty utility room is required that will accommodate facilities for bedpan cleaning/disposal, urine testing, an enclosed sluice and space for short term storage of used procedures hot-lock trolleys and instruments prior to return to a central decontamination room for bio-decontamination and recycling. Hand washing facilities must be provided. A minimum area of about 15–16m^2 should be provided, this area may need to be increased if local policies on disposal services require more than very temporary provision for bagged disposal items, see also HBN 40: 'Treatment areas' Vol. 2 for general layout and requirements. Depending on location and local policy, this room may be shared with other units, for example, the ITU and/or CCU.

Local storage facilities

7.241 Local storage facilities should be provided for disposables, fluids, hoists, special mattresses, bulk supplies and equipment. They may be shared with other units in a clustered solution.

Pantry

7.242 A pantry for serving patient meals and beverages should be provided. It may be shared with other units, depending on location. Hand washing facilities must be provided.

Interview/counselling room

7.243 There should be access to an interview/counselling room, to accommodate up to five persons. It may be shared with other units in a clustered solution.

Special features

7.244 These are as follows:

- each bed space should be at least 3m wide to allow for use of bulky equipment, including ECG, echocardiography and mobile chest X-ray equipment, that is in regular use. Equipment and services should be gantry-/pendant-mounted. In addition, each bed-head requires a minimum of four oxygen outlets, three suction outlets, three medical compressed air outlets, and 12 double electrical socket outlets. Hand washing facilities must be provided;
- mobile X-ray examination is a frequent procedure and power supply, equipment storage and maintenance and radiological protection for staff and patients are vital considerations that need to be discussed locally;
- each bed space should include a clinical hand-wash basin;
- bed spaces require easy surveillance from staff base, while affording visual privacy for patients as needed, using a curtain system in multi-bed areas;
- the multi-bed area and single bedrooms require natural daylight and, where possible, a view. Exceptionally, and depending on local circumstances, the requirement for the latter in the case of single rooms may be met if there is a reasonable level of 'borrowed' lighting available through glazed partition from the multi-bed area;
- special attention must be paid to the infection control and environmental requirements of isolation rooms;
- all patients require access to life-support equipment that includes ventilators, special multi-parameter monitoring, specialist beds, etc;
- an emergency power supply, both by generator(s) and UPS, is required;
- modern communications systems are required, to summon help, access data and share expertise.

Functional relationships

7.245 The intermediate care unit should be conveniently close to:

- the cardiothoracic ward;
- the ICU and/or CCU (see discussion of clustering in paragraphs 7.197–7.199); and
- the anaesthetic department and offices of consultant surgeons and cardiologists.

Coronary care unit

General

7.246 This unit is Category 3. The CCU is one of the most vital facilities in cardiac care and may be regarded as essential in all general, but not paediatric, centres. The most common association is with a cardiac inpatient unit or cardiac ITU. If the latter then they are sometimes incorporated into larger clusters where the opportunity to share core support services and facilities is very much enhanced. For the purposes of this guidance, however, a 'stand alone' facility is assumed, but reference is made to the possibility of clustered solutions, see discussion of clustering in paragraphs 7.197–7.199.

7.247 The number of beds provided within the intermediate care unit will vary with local policy and estimates of throughput. For the purposes of this guidance, 10–12 beds per 250,000 catchment is recommended. This is a substantial increase on the existing level of provision and is geared to reduce acute cardiac care requirements in areas such as A&E

7.248 The CCU is an area where patients may be acutely ill and require intensive nursing support. It is emphasised that the care regime imposed by CCU staff is designed to provide active rehabilitation rather than simply carefully monitored bed rest and clinical monitoring/support.

Functions

7.249 The CCU should provide accommodation for patients suffering from cardiac abnormalities who require continuous monitoring, or who have suffered an acute cardiac emergency such as acute myocardial infarction. It should also accommodate patients not stable enough to return to cardiology wards after invasive cardiology procedures. Exceptionally, patients referred from other hospitals for admission to an ITU will be admitted on a temporary basis to a CCU if no beds are available.

7.250 It should provide, as an essential and fundamental prerequisite, an environment in which patients who are particularly vulnerable to infection can be nursed safely, including facilities for barrier and reverse barrier nursing.

7.251 It should enable the development of staff with a wide range of skills and provide facilities for teaching.

Specific exclusion

7.252 The unit will not normally accommodate patients requiring artificial respiration, who will be treated in the ITU, but see paragraph 7.249 above.

Components

Entrance/waiting area

7.253 A patient reception and transfer area is required, including a trolley bay. It may be shared with other units in a clustered solution.

Visitor waiting area

7.254 A visitor waiting area is required, with access to sanitary and beverage facilities, including provision for the disabled. The entrance to the department should be strictly controlled, with short visits allowed throughout the day. It may be shared with other units in a clustered solution.

Overnight visitor accommodation

7.255 See paragraphs 5.115–5.116.

Multi-bed bay

7.256 A multi-bed bay, typically 4–6 bed spaces, is required. The majority of patients require access to multi-parameter monitoring. Each bed space must be provided with oxygen and suction, and electrical sockets. There must be enough space around the bed for use of resuscitation and echocardiography equipment.

Temporary pacemakers may need to be inserted while patients are within the bed space, so space will be needed to accommodate a C-arm image intensifier and screening monitor.

Patient WC and shower facilities

7.257 Adequate space for double lift assistance of patients should be provided.

Staff base

7.258 An associated staff base should be provided, with monitors linked to individual bed spaces and a clear and unobstructed view of multi-bed bays and, so far as is consistent with barrier nursing requirements, the single rooms. Resuscitation equipment should be kept near to the staff base, see also HBN 40: 'Staff areas' Vol. 3 for general requirements. Facilities for hand washing must be provided.

Clean utility room

7.259 A clean utility room is required that will accommodate a drugs cupboard, drugs fridge, lockable medicines cupboard, work surfaces and space for laying up procedures trolleys. A minimum area of approximately 18m^2 should be provided, see also HBN 40: 'Treatment areas' Vol. 2 for general layout and requirements. Facilities for hand washing must be provided. Depending on location and local policy, this room may be shared with other units, for example the ITU and/or CCU.

Dirty utility room

7.260 A dirty utility room is required that will accommodate facilities for bedpan cleaning/disposal, urine testing, an enclosed sluice and space for short term storage of used procedures trolleys and instruments prior to return to a central decontamination room for bio-decontamination and recycling. A minimum area of about 15–16m^2 should be provided, this area may need to be increased if local policies on disposal services require more than very temporary provision for bagged disposal items HBN 40: 'Treatment areas' Vol. 2 for general layout and requirements. Facilities for hand washing must be provided. Depending on location and local policy, this room may be shared with other units, for example the ITU and/or CCU.

Storage facilities

7.261 Storage for equipment/supplies, including major items such as a C-arm image intensifier and monitor, echocardiography equipment, and for an anaesthetic machine and other cardiac specific equipment such as intra-aortic balloon pumps, extra corporeal membrane oxygenation (ECMO) and ultra-filtration equipment. These facilities may be shared with other units in a cluster solution.

Pantry

7.262 A pantry for serving patient meals and beverages should be provided. It may be shared with other units, depending on location. Facilities for hand washing must be provided.

Interview/counselling room

7.263 There should be access to an interview/counselling room, to accommodate up to five persons. It may be shared with other units in a clustered solution.

Staff rest room

7.264 A staff rest room with a beverage bay should be provided, typically to accommodate 12–15 persons. It may be shared with other units in a clustered solution, but in this case total numbers to be accommodated would need to be re-calculated.

Special features

7.265 These are as follows:

- each bed space should be at least 3m wide to allow for use of bulky equipment (e.g. ventilators, balloon pumps, dialysis machines and special airbeds) that is in regular use. Equipment and services should be gantry/pendant mounted. In addition, each bed head requires a minimum of four oxygen outlets, three suction outlets, three medical compressed air outlets and 12 double electrical socket outlets;

- mobile X-ray examination is a frequent procedure and power supply, equipment storage and maintenance and radiological protection for staff and patients are vital considerations that need to be discussed locally;
- each bed space should include a clinical hand-wash basin;
- bed spaces require easy surveillance from staff base, while affording visual privacy for patients as needed, using a curtain system in multi-bed areas;
- the multi-bed area and single bedrooms require natural daylight and, where possible, a view. Exceptionally, and depending on local circumstances, the requirement for the latter in the case of single rooms may be met if there is a reasonable level of 'borrowed' lighting available through glazed partition from the multi-bed area;
- special attention must be paid to the infection control and environmental requirements of isolation rooms;
- all patients require access to life-support equipment that includes ventilators, special multi-parameter monitoring, specialist beds, etc;
- an emergency power supply, both by generator(s) and UPS, is required;
- modern communications systems are required, to summon help, access data and share expertise.
- a quiet restful environment is a fundamental requirement. Some patients experience enhanced sensory perception as a result of drug therapy, so it is important that aural and other adverse sensory stimulation is kept to a minimum.

Functional relationships

7.266 The CCU should be conveniently close to:

- the cardiothoracic ward;
- the ITU/intermediate care unit (see discussion of clustering in paragraphs 7.197–7.199);
- the minor procedures room;
- the medical units and cardiologists' offices;
- the admissions ward;
- the catheter laboratories;
- the A&E department.

7.267 Direct ambulance access should be provided where feasible. If the CCU is not at ground level, dedicated lift access is recommended. Providing dedicated routes for emergencies to ensure that access to the CCU is as direct as possible, and travel times are minimised, can have a direct effect on saving lives.

Cardiac rehabilitation

General

7.268 This is Category 3, or it may be a function of a main hospital department, in which case it is Category 1. Cardiac rehabilitation is a broad service primarily aimed at ensuring a return to quality life for patients by exploiting their potential for recovery and development. In addition, there are protective aspects concerned with reducing the risk of future heart attack. Some aspects, particularly those related to personal habits and health education, will require involvement of the patient's family or other supports.

7.269 The standard approach is seen in terms of four phases:

- Phase 1 – In bed. Interview either in bed or in the interview room in preparation for discharge;
- Phase 2 – At home, post-discharge. Hospital-based telephone support provided for 4-6 weeks for post-myocardial infarction (MI) patients, six weeks for post-surgery patients;
- Phase 3 – Outpatient, exercise sessions combined with health education. Twice per week for 4-6 weeks;
- Phase 4 – Patient groups support, e.g. Take Heart – exercise classes. Although not part of NHSScotland services, rehabilitation staff frequently provide support on a voluntary basis. Sessions are weekly and patients continue for as long as they want. Heart Guard is an example of a similar scheme supported by a voluntary organisation.

Rehabilitation gymnasium

Patient journey for Phase 3

7.270 The journey may be divided into a number of simple steps:

(i) The patient will generally arrive by car with partner or relative. Local car parking is seen as a significant advantage and some patient groups have pursued this view.

(ii) The patient should already be appropriately dressed. Where this is not the case, local changing should be provided.

(iii) The patient will go straight to the gym where all activities, exercise and health education, take place. Generally, sessions occur twice per week in a gym and last for two hours. The first hour is broadly exercise; the second hour consists of health education classes. Classes include relaxation/stress management, diet/nutrition, medication, exercise, and basic life support. Coffee/tea is available during or after these activities.

(iv) Confidential individual consultations may be required during sessions. A room for such private sessions will be required and should be of informal and relatively relaxed character.

(v) Patient goes home at end of session generally by car, although facilities for hospital or public transport are also relevant.

Components

Gymnasium

7.271 A gymnasium must be provided for the use of patients. It will be equipped with floor mats, parallel bars, wall bars and walking aids. Exercise equipment will generally include, as a minimum, two treadmills, two mini-trampets, mattresses, up to six exercise bikes, exercise benches, steps, and an open exercise area. A drinking fountain/beverage bay should also be located in this area.

Dedicated storage space

7.272 There should be dedicated storage space for two respiratory machines and a resuscitation trolley to include a defibrillator.

Patient education/teaching area

7.273 A patient and supporter education/teaching area should be provided, to accommodate e.g. 30 persons seated, and to have facilities for audio-visual lecturing. Alternatively, dual use of the gym may be more effective in some centres, dependent upon demand and staffing levels.

Examination room(s)

7.274 An examination room is required, with a desk and facilities for examining prone and standing patients, weight and height measurement facilities, etc. Oxygen and suction points will be required in this room.

Counselling room

7.275 A counselling room should be available, with desk and seating accommodation for counsellor, patient and relative(s), storage of information sheets, etc.

Patient showers

7.276 Patient showers, WCs, hand washing and changing facilities are required, separately provided for men and women and with appropriate disabled access.

Staff showers

7.277 Staff showers, WCs, hand washing and changing facilities are required, separately provided for men and women and with appropriate disabled access.

Staff rest room

7.278 A staff rest room with beverage bay should be provided.

Storage facilities

7.279 Storage facilities for equipment, including loan items, are required. Many items are relatively bulky and will require well organised and accessible storage.

Staff offices

7.280 Staff offices are required to accommodate e.g. four therapists and three nurses. Particular care over both internal and community communication facilities is required.

Cleaner's room

7.281 A cleaner's room should be provided.

Outdoor walking circuit

7.282 An outside walking circuit incorporating steps and seats, conveniently located adjacent to the ward areas, would be an excellent addition to inpatient rehabilitation facilities.

Special features

7.283 The need for the following identifiable features is noted:

- disabled access is essential, including access to changing and sanitary facilities. Bed access is also required to the gym;
- finishes and furniture in therapy areas should be robust. The gymnasium floor should be sprung. Floor finishes should be non-slip;
- noise attenuation will be required in the gym;
- emergency call buttons will be required in all patient therapy areas;

- appropriate ventilation and air cooling will be required in the gym;
- colour-corrected lighting will be required in clinical rooms only.

Functional relationships

7.284 The cardiac rehabilitation department should ideally be close to cardiac inpatient accommodation. Inpatients attending the gym for rehabilitation may be medically unstable, so to be close to medical staff is therefore essential.

7.285 Facilities for outpatient attendees should be close to parking, including disabled parking.

Cardiac/cardiothoracic departmental accommodation

General

7.286 This provision is Category 3.

Functions

7.287 Departmental accommodation should be designed to allow consultant medical staff and their secretarial support to communicate effectively both within and across clinical specialities, enabling them to deliver their clinical commitments effectively.

7.288 This accommodation is a setting for clinical teaching and research not involving the physical presence of patients.

Components

7.289 These are as follows:

- offices for consultants and secretaries;
- adequate seminar facilities, with audio-visual services, departmental library, etc; and
- other facilities to accommodate teaching and research activities, to be discussed with the client.

Functional relationships

7.290 While it is important that members of specialist consultant teams have ready access to their specific ward and operative areas, it is equally important that their offices should generally have close proximity to each other, to offer better cover, to streamline referrals between specialities, and to allow close proximity to research facilities.

Non-Cardiac-Specific accommodation

7.291 There is, in addition to the Category 3 facilities in the previous Sections, a need for the cardiac/cardiothoracic service to access services located in departments that lie outside the physical boundaries of the cardiology centre footprint, and outside its clinical governance also. The following services are Category 1 unless local circumstances dictate otherwise, in which case they are Category 2.

Inpatient services

7.292 It is assumed that cardiac/cardiothoracic inpatient requirements will be met from the general bed stock of the hospital in the form of dedicated access to designated wards. If major new facilities for cardiology on a particular site are in prospect, and if as a consequence additional beds are required and physical circumstances allow, there would be some merit in considering whether cardiology and cardiothoracic beds could or should be co-located with, or form a part of, the cardiology centre. Such a decision would however have to be taken in the context of the whole hospital's operational and bed management policies.

Diagnostic imaging

7.293 It is strongly recommended that all simple non-invasive X-ray and other non-invasive imaging be undertaken in the main X-ray department, which should be conveniently accessible for cardiac/cardiothoracic patients. Except in special local circumstances, magnetic resonance imaging (MRI) procedures should be undertaken in the main department also. Issues that bear upon this decision include optimal use of expensive equipment and trained staff (MRI) and quality control generally (all procedures).

Shared nuclear medicine facility

7.294 See paragraphs 7.65 – 7.74 on 'Cardiac isotope scanning facilities'. As some scans are undertaken on patients who have been physically or pharmacologically stressed, it may be necessary to adapt conventional scanning facilities to incorporate this element of the cardiac isotope scanning programme (Category 2).

General pathology and laboratory based medicine

7.295 Cardiac services make substantial demands on laboratory services. For convenience, these should be close to the cardiac centre, but vacuum tube connection is now regarded as an effective substitute for physical proximity.

Accident and emergency services

7.296 See paragraphs 5.20–5.23.

7.297 A critical factor in the treatment of patients with severe heart pain admitted through the A&E department is access to angiography facilities. There is evidence that lives could be saved if satellite angiography facilities were available in the A&E department, assuming that the main angiography laboratories could not be planned to be contiguous with that department. Generally, the A&E department is considered to be Category 1, since the facilities must be available to identify and stabilise heart emergencies regardless of overall policy. If, however, this strategy were to be adopted, it would clearly have implications for the design of the department, bringing it into Category 2.

Teaching and research

7.298 It is assumed that where such facilities are not provided as an integral part of clinical or departmental space they will be provided centrally.

Clinical and non-clinical support services to which cardiac/cardiothoracic units will require access

7.299 Like any other clinical service, cardiac/cardiothoracic services must have access to, or be accessed by, a wide range of clinical and non-clinical supporting services departments.

Clinical

- pathology;
- CSSD;
- pharmacy;
- medical records; and
- electro-medical engineering services.

Non-clinical

- administration services;
- linen and laundry services;
- catering;
- general stores distribution services;
- hotel services; and
- facilities maintenance.

8. Engineering services

Introduction

8.1 This Section describes specific engineering services requirements for cardiac services facilities. It complements the general engineering services guidance given in SHPN 03: 'General design guidance'. The combined guidance should not inhibit the design solution, but will acquaint the engineering members of the multi-disciplinary design team with the design criteria and material specification needed to meet the functional requirements. Specific requirements should be formulated in discussion with both end-users and manufacturers of specialist equipment. Some issues, particularly those related to radiation safety, will require specific and detailed discussion with other professional consultants, including the local radiation protection advisor (RPA).

8.2 This Section is mainly concerned with the proper installation of the equipment in a suitable environment to enable high standards of reliability. However, designers should also consider the needs of patients who may be attending from areas of critical care and therefore attention should be paid to standards of infection control and overall cleanliness, also refer to Scottish Health Facilities Note (SHFN) 30: 'Infection control in the built environment – design and planning'.

Activity data

8.3 Significant gains in both management and patient services may be expected from the provision of a wide bandwidth LAN and associated computing equipment. This may be especially true in the area of X-ray cardiac imaging.

Safety

8.4 The 1999 Ionising Radiations Regulations, the 2000 Ionising Radiation (Medical Exposure) Regulations and the associated Codes of Practice place onerous requirements upon engineering aspects of design and operation of diagnostic cardiac imaging modalities. Over and above this, there are additional requirements from the 2000 Radioactive Substances Act in respect of storage, use and disposal of radioactive materials. The RPA and custodian of radioactive substances must be consulted in this regard.

Space for imaging generators, transformers, computers and plant/services

8.5 Where appropriate, space for electrical equipment, such as generators, gradient cabinets, plant and services should provide easy and safe means of access,

protected as far as possible from unauthorised entry. Authorised entry will be needed for inspection and maintenance. Sufficient access panels should be provided for this purpose. In the provision of panels and access points, consideration must be given to ensuring the integrity of fire barriers and that the control of smoke is appropriately maintained.

8.6 All mechanical and electrical services entering rooms potentially containing radiation must be routed through specially designed access ports so that shielding is compromised as little as possible. It may also be necessary to design-in changes in direction of ductwork, and cable containment systems to provide protection against radiation leakage in some examination rooms, for example in the imaging rooms containing angiographic equipment. The RPA and original equipment manufacturer will need to be consulted with respect to the above.

8.7 In some installations, existing services may pass into the room at low level, from an adjacent plant or technical room and rise into their final position close to the actual imaging equipment. An example of this configuration would be centrally located Angiography equipment mounted on a combination of a C-arm and L-arm as described elsewhere.

8.8 The precise installation arrangements will be project specific and should be determined with the installation specialist of the original equipment manufacturer.

Access to control and isolation devices

8.9 In a diagnostic area the access arrangements must not compromise the radiological protection provided for these rooms. Consideration should be given to the comfort as well as the safety of patients and others.

Engineering commissioning

8.10 The services for some diagnostic cardiac imaging equipment may require to be commissioned before the final completion of the engineering contract programme, to allow the imaging equipment commissioning to be completed prior to the arrival of the first patient. Parts of this commissioning are concerned with radiation safety and the approval of the RPA must be obtained for the imaging processes and schedules proposed.

Mechanical services

Ventilation

8.11 The majority of the areas within the facility will require mechanical ventilation, due to equipment heat gains, patient/staff numbers and clinical reasons.

8.12 The supply plant for ancillary accommodation should be separate from plant serving the cardiac imaging equipment.

8.13 A separate extractor system will be required for 'dirty' areas, for example, toilet facilities and dirty utilities. It should operate continuously throughout the day and night. A dual motor fan unit with an automatic changeover facility should be provided.

Ventilation controls

8.14 Supply and extractor ventilation systems should include indicator lamps to confirm the operational status of each system. Where a system is provided for a particular space, the indicator should be in, or immediately adjacent to, that space and local controls should be provided as appropriate. In the case of a more general system of ventilation, for example WCs, the indicator should preferably be located at the reception desk or other suitable location. Where manual controls are available for staff use, they should be provided with labels clearly defining their function. Where manual overrides of time switches controlling the running periods of ventilation plants are provided, they should be grouped with the temperature control overrides designed to cope with changes in operating conditions including prompt start-up of imaging systems.

Ventilation (substances hazardous to health)

8.15 In the provision of cardiac imaging services this will primarily relate to the use of radioactive substances in radio-nuclide imaging or nuclear medicine.

Piped medical gases

8.16 In any special procedures room where nitrous oxide is used, provision should be made for active scavenging of waste anaesthetic gases in accordance with the recommendations of BS EN 737/ BS EN 740. See also SHTM 2022: 'Medical gas pipeline systems'.

Hot and cold water services

8.17 Special considerations exist in MRI and are outlined in the engineering section of SHPN 06: 'Facilities for diagnostic imaging and interventional radiology'.

Electrical Services

Illuminated signs

8.18 At each entrance of a controlled radiation area of an X-ray imaging suite, a safety sign and a warning lamp must be provided in order to warn people that they are entering a controlled radiation area and to comply with the statutory requirements for radiological protection (the 1999 Ionising Radiations Regulations). The warning lamp must give a clear indication in red when it is energised and may incorporate the legend 'Do not enter', visible only when

illuminated. All warning lamps should have incandescent filaments energised from a suitable power source within the room and switched via appropriate devices interlocked with the operation of the diagnostic equipment.

8.19 Exceptions to this design requirement are where the means of access is interlocked with the equipment and controlled directly by the staff, for example where outpatient changing cubicles are designed to be directly adjacent to the X-ray imaging room.

8.20 Other illuminated signs may also be required within the department. All such signs should be connected to essential supplies where necessary.

Socket outlets and power connections

8.21 Sockets provided to supply all portable appliances should not be connected to circuits that are used in conjunction with X-ray units, due to the possibility that these systems may 'pass' considerable amounts of energy to earth. It is likely that some of these sockets will be used in conjunction with patient monitoring equipment. Care should be taken to ensure that sockets on different phases are placed at least 3m apart and under no circumstances should a patient be served with sockets, or equipment, on different phases.

8.22 Socket outlets in consultation/examination/ treatment areas, and wherever X-ray films are processed, reported on or stored, should be connected such that within each area a supply is available from at least two separately fused circuits of the same phase.

Electrical supplies to cardiac imaging equipment

8.23 The imaging performance and overall reliability of cardiac imaging equipment can be severely compromised if the systems are connected to contaminated electrical supplies. This will also be the case where there is a higher than required impedance on the earth circuit measured directly back to the central protective earth of the hospital. It is therefore advised, as part of a risk control strategy, that, before installing new or replacing old diagnostic imaging equipment, analysis of the proposed incoming power supply including the earth and neutral lines should take place. The analysis should take place for at least 24 hours, during normal working hours, and look for surges, spikes, sags and electrical variations in the earth. The data collected should be reviewed with the original equipment manufacturers to ensure that it meets their specifications in terms of tolerance values.

8.24 The electrical supply connections to all medical electrical equipment should comply with the requirements of BS EN 60 601-1-2:1993. Diagnostic imaging equipment should be installed to a WYE standard and to meet the standards of BS7671 – electrical installations in buildings, including Guidance Note 7 – special locations, section 10 medical locations (IEE 16th Edition) in its latest revision. In essence, the majority of diagnostic imaging equipment will require a three-phase supply up to 480V and 30A per phase, at 50Hz. In addition, a separate neutral line and earth connection will be required to meet the

installation requirements. The majority of diagnostic imaging equipment is manufactured and originally tested outside the UK and is designed to meet the USA 60Hz system. Before the equipment is transferred to the UK, a 60 to 50Hz conversion is made. The original equipment manufacturers have solved virtually all conversion problems, but, on the rare occasions that problems are observed at the electrical installation and commissioning stage, investigation may be required.

8.25 Advice on the power supply and requirements for fixed and mobile diagnostic imaging equipment is contained in SHTM 2007: 'Electrical services – supply and distribution'. Individual project requirements should be discussed at an early stage with manufacturers and/or suppliers of equipment.

8.26 Individual project requirements, including the relative arrangements of rooms within the department, will largely decide whether a radial or ring type feeder system is appropriate. While lower circuit impedance favours the ring circuit, difficulty in looping heavy current cables at the terminals of switchgear should be borne in mind. The sharing of final feeders between several X-ray diagnostic imaging rooms should take account of the diversity of usage, with particular reference to exposure duration and frequency and the provision of a clean electrical supply to meet manufacturer's requirements. The lowest diversity is accorded to the equipment used for X-ray fluoroscopy/fluorography and interventional procedures. Power terminations within diagnostic rooms should be appropriately protected by a fused switch.

8.27 The earth connection at the power termination should be suitable for the functional earth requirements specified by the radiology equipment manufacturer, and be arranged to receive a direct connection from the earth reference terminal, which should be provided or designated in every diagnostic imaging room. The purpose, characteristics and performance criteria of an earth reference terminal in a diagnostic imaging room are described in the 'protective earthing' section of the Department of Health's specification document TRS 89 relating to the supply and installation of equipment for diagnostic imaging and radiotherapy equipment. This should also meet the requirements of the latest edition of BS7671:2001 'Requirements for electrical installations' (IEE Wiring Regulations) 16th Edition. The earth wire should be of copper, rather than steel wired armoured design, to minimise the impedance between any part of the equipment and the earth reference terminal. The provision of separate 'earth mats' may be appropriate for some items of equipment where the impedance measured to the central protective earth of the hospital is higher than that specified by the equipment manufacturer. They may also be appropriate where there is a requirement to maximise the reliability and imaging performance of the equipment. Routine checks should take place annually and a thorough testing should be undertaken at a period not greater than five years, as advised by Guidance Note 3 of BS7671: 2001 'Inspection and Testing'.

8.28 Numerous electrical interconnections are required between the separate components associated with a complete diagnostic suite installation. Conduit and cable trunking should preferably be installed by the electrical sub-

contractor, to a layout satisfying the requirements of the original equipment manufacturer, who will normally supply and arrange for the installation of the interconnections. Some cables have limitations on maximum length and radius of bends, for example, high-voltage cables.

8.29 While it is preferable for all the components associated with a diagnostic room to be located therein, the relative positions will depend on operational requirements and room features. Control consoles and control equipment cabinets, however, are usually located adjacent to or against perimeter walls. With these features in mind, the cable distribution may be accommodated in a perimeter floor duct located approximately 200mm from the walls, from which spur ducts traverse the floor to island equipment or rise via wall-mounted units to terminate at cable trunking above the ceiling.

8.30 Floor trunking should be of the continuous-lid load-bearing variety of at least 75mm screed depth. Changes in direction of trunking should be provided with an internal angle gusset. All trunking lids, when removed, should give total access, so that cables may be laid in, rather than drawn into the trunking. This does not preclude the possibility of drawing in individual cables during periodical maintenance by lifting lids only at angles or T-junctions. Should it be necessary for trunking to pierce walls, there should be adequate straight sections on either side of the wall to enable pre-formed cable termination assemblies to be fed through such an opening without difficulty. There is a requirement to maintain fire barriers and integrity where trunking passes through designated fire compartments.

8.31 The surface finish of cable trunking visible within cardiac diagnostic rooms should be commensurate in quality with the equipment consoles, cabinets and overall clinical function of the suite as described in SHPN 06: 'Facilities for diagnostic imaging and interventional radiology'. Conduit or trunking routes piercing radiological barriers, for example diagnostic room perimeter walls, should be provided with adequate radiation shielding or dense in-fill material.

Electrical interference

8.32 In diagnostic imaging, there may be some cases where there is a requirement to site other electronics cabinets, not connected with the imaging system, mains power outlets or the earth reference terminal at least 1.5m away from the X-ray generator cabinets and transformers. This may need to be undertaken to minimise the risk of interference to the imaging system and induction of voltages in the electrical earth.

Staff location system

8.33 The hospital staff location system should be extended to include this department. Further guidance is contained in SHTM 2015: 'Bedhead services'. There are particular advantages to the use of such systems in diagnostic imaging. For example, patient groups who have undergone interventional

procedures have emphasised the value in continuity of contact with a familiar care team and individual members of staff.

Telephones

8.34 Depending on local policy at least one ex-directory line should connect directly with the local ambulance services control centre. It should have a distinctive bell, buzzer and colour or other distinctive marking.

8.35 Phone connections may be required from each of the modality control consoles to allow remote monitoring of equipment by manufacturers at their UK or foreign bases.

Intercom systems

8.36 Due to the character of the diagnostic techniques used within imaging services, it will be appropriate to provide intercom stations in addition to the telephone and call systems. These permit 'hands-free' speech contact, either staff/staff, patient/staff or staff/patient. Consideration should be given to the local circumstances and treatment/imaging methods or procedures.

Data and equipment links

8.37 Data systems specific to diagnostic imaging include:

- PACS networking or mini PACS systems, including those necessary for RIS and HIS terminals, where appropriate;
- coaxial cabling, for example from a modality to a laser printer or print manager/router/hub;
- reporting systems in the form of digital dictation units networked to secretarial offices.

CCTV

8.38 Closed circuit television should be provided, where required, to monitor patients undergoing treatment in restricted areas including CCU. The interference to which such equipment may be subjected should be considered when it is specified, to ensure acceptable electromagnetic compatibility. Care should be taken in the positioning of monitors in order to preserve patient privacy.

8.39 CCTV systems may be required in certain examination rooms under the appropriate modality. Colour CCTV systems may be required, in order to monitor from a more remote location, from a control area, when they are undergoing general anaesthesia or sedation.

8.40 CCTV systems may also be particularly useful where cardiac imaging serves the A&E department.

Internal drainage

Chemical and radioactive contaminated effluent

8.41 The drain from the toilet and radioactive waste disposal sink associated with the diagnostic room where radio-nuclide imaging is undertaken will carry radioactive effluent. It must be sealed throughout its run to the main sewer and its route chosen with regard to the areas likely to be affected if leaks develop. It is recommended that drainage for this purpose should not be into a pumped system. The RPA or an appropriate expert in this area should be asked to undertake a risk assessment for releasing radioactive substances into the environment to ensure that members of the public are not subjected to excess risk. Designers must ensure that all risks associated with contaminated effluent are conveyed to the pipework maintainers, who in turn must implement procedures to ensure that members of staff are not exposed to potential risks from these substances.

8.42 At an appropriate early stage in the design process, project teams and local water companies should discuss and verify the project proposals for the collection and discharge of chemical and possibly radioactive contaminated effluent. Local water companies will probably advise on restrictions on the quantity and rate of discharge of such effluent into public sewers.

Transfer of equipment to installation site

8.43 The method used to bring diagnostic equipment into a department may need to be carefully considered. Although the majority of diagnostic imaging equipment is broken down into modules for transportation and then re-assembly on site, these modules can be large and in some cases have masses that exceed 1 to 2 tonnes. The equipment will usually be transferred in wooden crates, which has the effect of increasing the overall dimensions. It is therefore advised that architects and estates managers consider at early planning stages how the equipment will be transferred to the proposed site. Care needs to be taken over the width and height of doors, loading specifications for floors and the turning circles of the equipment.

Special structural engineering requirements for cardiac imaging and interventional systems

Floor and ceiling loading

8.44 In the provision of floors for cardiac diagnostic imaging equipment, traditional construction methods consisting of a concrete slab or sub-floor with a screed of normal thickness may not allow the flexibility needed when installing interconnecting cables between items of equipment. This failure may become apparent when equipment is renewed, an activity that may take place a number

of times during the lifetime of a building or facility. This problem is not as acute now as it was ten years ago, because the equipment has become more modular, more compact, there are fewer interconnecting cables and the installation methods have been developed further by the majority of X-ray manufacturers.

8.45 There is also the possibility that the function of the room may change. The floor in the general X-ray room should be capable of supporting a total load of up to 5000kg, although no single item of equipment is likely to weigh more than 2500kg. Manufacturers and suppliers should be consulted on the likely weights of such equipment. The floor should permit easy installation of trunking, 100mm in depth, with a minimum cross-sectional area of 150cm^2 required for cables to equipment and other apparatus.

8.46 Considering the above requirements and reports of problems with lightweight and load bearing access floor designs, it is advised that standard floor construction methods are used when installing X-ray equipment for cardiac imaging and interventional equipment in the actual room itself. Other possibilities exist for the control area and other supporting facilities and these are described further below.

8.47 Diagnostic imaging and interventional facilities should be installed on the ground floor, as this reduces the complications of installing and transferring equipment to the designated space. However, if imaging modalities, possibly as part of a department, need to be located on an upper floor, this can only be achieved at the expense of restricted storey height to the accommodation below. The load bearing capacity of the main hospital lifts may have to be increased in order to take the weight of the imaging equipment. Alternatively, large heavy lifting cranes may have to be used to transfer the equipment into the department. The radiological protection of people offered by the floors, walls and ceiling around the imaging examination room will have to be considered and discussed with the RPA at an early design stage. This may result in increasing the size of the structural floor slab, for example, or the use of lead lining in the walls or barium plaster.

8.48 Floors with increased thickness of screed (over-slab) incorporate an increased depth of floor screed with a perimeter ring cable duct from which connections may be made to the generator, equipment racks and control console.

8.49 In the event of equipment being enhanced or renewed, additional cable trunking risers may be required to be connected into the perimeter duct.

8.50 The perimeter ring duct needs to have a clear internal height of 100mm and will normally be constructed of galvanised steel with a suitable flush finished removable lid. The floor finish should be continuous and sealed, but have a welded inset to delineate the position of the floor duct and access points.

8.51 This type of floor would, therefore, consist of:

- a continuous sealed floor finish;
- a minimum of screed depth of 75mm to accommodate the trunking and cables used by the X-ray units. Ideally the same thickness should be used throughout the department to form a single level floor;
- a separating membrane;
- a structural floor slab or a concrete sub-floor;
- a perimeter duct of 100mm clear height and 150mm minimum clear width.

8.52 The drying-out period for over-slabs of this nature is significant and may well be in the region of 25 weeks. Account of this should thus be taken at an early stage in the construction programme. However, certain types of over-slabs laid by specialist contractors offer substantially reduced drying-out periods.

8.53 To ensure ease of access for wheelchairs, trolleys and beds, the floor surface should be at the same level as the surrounding corridors. For hygiene and ease of maintenance, the floor finish should be impervious to fluids.

8.54 Careful consideration should be given to the route of cable runs between the generators and electrical supply cabinets to the X-ray and the patient couch, which will usually incorporate powered movements in all three orthogonal directions.

8.55 In general X-ray imaging rooms, there must be a clear minimum height of 3.1m, over the whole room, between the finished floor level and the underside of the support grid for the direct suspension of radiological equipment to enable certain types to be operated over their full working range.

Control and support machine room options

8.56 A further option exists for the installation of floors in separate machine and control rooms associated with the use of specific imaging modalities, in the form of a lightweight modular access floor.

8.57 There should be consultation with the X-ray equipment manufacturers before installation. In some instances, there may be concerns regarding infection control and decontamination.

8.58 The lightweight modular access floor option allows for a hollow floor, which, in principle, offers complete flexibility for cable runs between the control and equipment and examination rooms and is similar in concept to a floor associated with a computer installation.

8.59 This type of floor would, therefore, consist of:

- a continuous sealed floor finish;

- a proprietary or similar modular access floor with a recommended clear depth of 200mm formed with standard floor panels, normally 600mm square, on adjustable screw jack supports;
- a structural floor slab or a concrete sub-floor with power-floated finish.

8.60 It may be necessary to give consideration to the detailing of concrete or steel supports to carry the loads of any large items of equipment, possibly modality control workstations. A base plate may be required, necessitating the trimming of floor panels around it. It is also particularly important to consider the movement of equipment during installation and how large items of X-ray imaging equipment may be moved through a support area.

Ceilings

8.61 The structural C-arm devices where the image intensifiers and X-ray tubes are mounted may weigh to 2 metric tonnes, and consideration of this factor should be given in overall planning and structural design terms.

8.62 To support the overhead equipment and its services, it is recommended that a load-bearing modular steel grid should be hung from the structural floor slab of the storey above. This will provide built-in flexibility for the choice and location of equipment, both initially and in the subsequent life of the building. The grid should be integrated with the suspended ceiling, concealing primary services distribution, and designed so that the tracks can be mounted wherever required at the level of the suspended ceiling. The latter should comprise demountable modular tiles with interchangeable recessed modular lighting fittings, which are capable of being placed in any desired position so that they are not obstructed by the equipment.

Construction of walls and radiation protection

8.63 There are two types of wall in diagnostic rooms, one of solid construction and the other hollow-core partitioning. The latter provides flexibility in the use of rooms and enables services to be installed within them. Both types of wall must provide radiation protection to the standards required to ensure that adjacent spaces are protected from ionising radiation. The structural protection required will depend on a number of factors, including the workload, energies of radiation used and the reduction in radiation exposure levels required to protect staff and the members of the public in adjacent areas. As a general guide only, 3 to 4mm of lead equivalence is usually adequate to provide sufficient radiation protection in general X-ray rooms and this can be achieved by the use of lead ply and barium plaster. The RPA should be consulted when determining requirements. Ducts, pipes, and holes through walls should be radiation protected by the use of dog-legs or other devices. Project teams should again consult the RPA for advice on the use of these devices. Walls should have a load bearing capacity for equipment, in particular for the provision of radiation protection equipment such as lead coats, jackets, etc. This requirement may involve a side thrust of up to 200kg and point loads of up to 100kg. Walls should be flush and without structural protrusions.

Lighting

Natural lighting

8.64 For the protection of people in adjoining spaces from the effects of radiation, the examination room should not incorporate any windows, although skylights or high level lighting may be provided depending on design and siting and the requirement to protect persons in adjacent areas from ionising radiation. If such skylights are installed, systems of work, local access rules and operational policies need to be put into place to avoid the risk to maintenance personnel working on roof tops. Blackout blinds must be provided in such instances, in order that the radiographers can darken the rooms as required.

Environmental aspects

8.65 Waste heat is generated by the X-ray tubes, high-voltage X-ray generator cabinets, other associated equipment and persons working in these rooms. If high-level roof lights are provided, they will need to be covered by blinds during some discrete stages of the examination, limiting the airflow of natural ventilation. General-purpose X-ray rooms therefore require mechanical supply and extract ventilation to dissipate waste heat and maintain comfortable conditions for staff and for patients.

8.66 According to the particular heating loads arising from the specific diagnostic equipment and from other design factors, it may be necessary for supply air to be cooled.

8.67 As described elsewhere, the use of mobile ceiling suspended X-ray tubes necessitates a minimum clear height requirement of 3.1m over a large proportion of the ceiling area, and also necessitates the installation of a substantial support framework above the ceiling. Mechanical ventilation grilles are therefore likely to be installed at high level around the perimeter of the X-ray room, and to be served by ductwork located above the suspended ceilings in adjacent areas.

8.68 Full air-conditioning and macro-filtration should be incorporated into the cardiac angiography suites and recovery area, and should be able to be manually controlled from within each area. This should be connected to a different electrical circuit to that used for the imaging equipment. In general terms, a maximum air change rate of between 12 and 15 air changes per hour is seen as appropriate to control room temperature and infection in the examination room.

8.69 The equipment should be operated between temperature ranges of +15ºC and +30ºC with relative non-condensing relative humidity of between 30 and 75% and pressures of 70kPa and 106kPa.

8.70 Care should be taken over the magnetic field environment around the equipment, as fringe fields from MRI scanners can downgrade the function of the image intensifier.

Artificial light

8.71 In most cases, the design and location of the light fittings will need to be integrated with the requirement for extensive ceiling tracks and support frames needed to support the movable ceiling mounted X-ray tube. The following are key requirements:

- patients under investigation who may be lying on patient tables should not have to look directly up into artificial lights;
- the movement of ceiling-mounted equipment should not unduly obstruct the light produced;
- variable levels of illumination should be made possible to enable certain tasks to be performed e.g.:
  - (i) variable but low levels of lighting are required for the proper viewing of examination room monitors. High levels of lighting can make it difficult for radiologists to perceive some anatomical structures during a procedure;
  - (ii) high intensity lighting is needed during equipment maintenance procedures.

8.72 The above operational requirements can be achieved by the use of fluorescent and small spotlights. It should be possible to eliminate the light from the fluorescent lights and vary the intensity of the spotlights by the use of dimmer switches.

8.73 The construction of modular suspended ceilings enables modular ceiling panels and recessed lighting fittings to be interchangeable. When a suspended ceiling cannot be provided, it will be preferable to install lighting fittings at or near the junctions of walls and ceilings. If lighting fittings are at lower levels on walls, or near to eye level, they can cause an uncomfortable glare.

8.74 Mobile examination lamps should operate at extra low voltage, be totally enclosed and should be equipped with a heat filter. The temperature of external surfaces should be such as to avoid injury to patients and staff. These luminaires should comply with the requirements of BS4533, Section 102.55 and be in accordance with the performance specification of Type A included in BS4533, Section 103.2.

8.75 Light fittings must be located with reference to the positioning of the X-ray table. Very carefully designed locally variable light level control must be provided in the imaging room. Poor lighting design, that, for example, fails to eliminate reflection on monitoring screens or allow local dimming can adversely affect fluoroscopic imaging perception.

8.76 Colour corrected lighting should be provided in all patient areas and in the image review room workstation. Level control and the avoidance of reflections in monitors in the image review room workstation are essential.

8.77 Emergency lighting and power should be provided in the catheter laboratories, recovery area and generator/computer rooms.

Power consumption

8.78 Generators for use with interventional fluoroscopy equipment will usually be rated at 80kW over 0.1 seconds and thus a maximum power consumption for the system of 145kVA can be expected.

8.79 Systems for cardiac angiography are fitted with a generator of 100kW rating, over 0.1 seconds, thus the maximum transient power consumption will be 185kVA.

Electrical supplies and UPS provision

8.80 In the event of an electrical power failure power during a procedure, electrical power to the system and associated support services should be maintained, in order to allow the clinician to remove any catheters or guide wires from the patient under imaging control. This can usually be undertaken using the fluoroscopic capabilities of the system and in this respect the maximum power required by the X-ray generator will be of the order of 2kW. In addition, to support this objective, power supplies will need to be maintained to the examination room monitors, imaging computer and associated control electronics. The use of UPS or emergency supplies should reflect the overall risk control strategies used in the installation of the equipment whilst in consultation with the original equipment manufacturer.

Maintenance – split cabinets

8.81 If the power control and generator cabinets are moved a relatively long distance from the actual X-ray unit due to space constraints, for safety reasons the company supplying maintenance and servicing to the X-ray systems may insist that they have two engineers on site during an inspection or repair. Generally, X-ray companies will insist on this measure when it is not possible, under any circumstances, to view the X-ray unit from the technical room. This may increase the cost of any maintenance contract for the provision of routine inspections and repairs. This should be considered at early planning stages and the position of electrical cabinets identified at an early stage.

Radio-nuclide and positron emission tomography imaging systems

Exacting environmental control

8.82 The expensive crystal detector within a gamma camera or PET imaging system can be damaged or cracked beyond repair if there is too rapid a rise or fall in temperature (>2ºC/hour) or other environmental conditions. The environmental conditions in the examination room must be appropriately controlled to

manufacturer tolerances and full air-conditioning provided. This will ensure that the equipment operates at optimum performance levels and may also reduce overall downtime. Consideration should be given to the provision of an alarm system that would be activated in the event of failure of the air-conditioning system or when the environmental conditions are outside those tolerances recommended by the manufacturer. For the majority of detectors, the temperature should remain between 20°C and 22°C with a non-condensing humidity of between 40% and 60%. These figures will vary between manufacturers and should be checked carefully before installation. The doors to the gamma camera room should remain closed for as much time as possible and be equipped with access controlled locks or systems to prevent unauthorised out of hours access.

8.83 It is essential not to have windows that open directly to the inside or outside of the examination room. If a window already exists, it must be double glazed to prevent temperature fluctuations and securely fixed to prevent unauthorised opening. Curtains or venetian blinds must be used on any window frame, as patients are required to partially undress and sit upright on the exercise machine for some studies. Under no circumstances should direct sunlight be allowed to fall on to the gamma camera. If a window has to be included in the design, there are also issues concerning radiation protection and limiting radiation exposures in adjacent spaces.

8.84 If radio-nuclide imaging examination procedures are to include the use of inhaled aerosols labelled with technetium, separate ceiling-mounted air extraction facilities, discharging to the open atmosphere, should be provided. The location of the discharge duct should be reviewed with the RPA and subject to COSHH assessment. This is to minimise the contamination risks within the examination room, in particular the risk of contaminating the face of the gamma camera, since this may have a direct impact on clinical image quality. If a radioactive gas, such as krypton, is used as an alternative to aerosols, it is probably not necessary to make provision for extract ventilation, as this radioactive substance has a very short half-life of approximately 10 seconds.

8.85 The air conditioning system needs to supplement the air flow with a fractional intake of filtered air from outside, in order to clear the stale air and odour originating from patients or from chemicals used for cleaning and disinfecting following the investigation on an MRSA-positive patient. The air in the room must be dust-free for protection of the camera mechanics and computer hard disks.

Electrical supply requirements

8.86 This must be a dedicated (clean) supply direct from the hospital's main incoming distribution panel, with earth reference terminal. The electrical supply to the equipment should not be shared on ring mains that generate transient high sudden loads, X-ray units, or motors to the lift, etc., as this may cause a failure of the equipment, unreliability or drop in the performance of the imaging system.

8.87 The specific power required by each camera will depend on the camera. This can be a 30A dedicated single-phase 240V mains supply or a three-phase 30A (total) supply. It is essential to meet manufacturer specifications in terms of tolerance values for frequency and power.

8.88 Isolating switches to these cameras must be within the camera room itself, for safety and for access by the service engineer.

8.89 Each camera room should have adequate 13A sockets for PCs, monitors, and physiological measuring devices. A minimum of five double 13A sockets located at various positions in the camera room are required. These should be off a separate mains ring and not from the supply to the imaging system or those used to power the X-ray systems as stated above.

8.90 Sockets must be easily accessible for easy connection to the monitoring equipment needed by patients with critical care requirements. They may also be needed for portable equipment such as a 'Technegas generator' or engineering test equipment.

8.91 There is a case for some of these sockets to be of the pendant type in the vicinity of the patient couch, to avoid the risk of accidents caused by tripping over mains cables trailing on the floor.

8.92 A common earth, with a single earth reference terminal, is essential for all mains supplies in each camera room, to avoid electrical shocks between equipment fed from different mains outlets.

Special local and site drainage requirements

8.93 Consideration should be given to shielding the trap from any sink that has been designated for the disposal of radioactive waste within a radio-nuclide imaging suite. Particular consideration should be paid to the disposal sinks in the radio-pharmacy and the injection room. In these cases, lead sheets could be laminated around conventional plastic fittings.

8.94 For all sinks designated for the disposal of radioactive substances it is advised that 'running traps' are utilised instead of the bottle traps normally provided.

8.95 The drainage from designated WCs and sinks, etc., should be separated from other sinks to minimise back-flow to other drains caused by blockages.

8.96 Plastic pipes may become contaminated with radioactive waste if they are continually exposed to radioactive substances. Therefore other non-absorbent materials should be used until the waste pipe reaches the main sewer or a point where there is sufficient dilution of the radioactive waste. This should be determined by a suitably qualified RPA.

8.97 Waste from the designated patient WC will also be radioactive and drains should also be designated and labelled accordingly.

8.98 If possible, drainage systems from disposal sinks and WCs should allow for maximum dilution as quickly as possible. They must be made of porcelain instead of stainless steel, as this material absorbs some radioactive species of isotopes that may be used in radio-nuclide imaging investigations.

8.99 All designated drain runs carrying radioactive waste should be labelled appropriately at all access points, either up to the perimeter of the hospital site, where it enters the main sewer or the point of sufficient dilution as determined by the RPA.

8.100 The route of such drainage runs should not pass areas used by vulnerable groups of patients before the point of sufficient dilution.

8.101 The drainage from sinks or toilets should not pass close to the gamma camera, as this may cause instability of the camera during imaging or excessive noise on the images acquired.

Security

8.102 All authorised staff working with radioactive substances are required for safety, security and regulatory reasons (Radioactive Substances Act) to keep accurate records of all the substances stored and used in the department, or entering and leaving the hospital. Radioactive sources have to be stored in secure environments. Routes for the delivery of radioactive substances should also be identified to avoid sources being accessed by unauthorised persons.

Ultrasound systems

Electrical supplies

8.103 Most ultrasound systems are powered by a single-phase 240V supply and are commonly powered using standard 13A sockets. The exact electrical installation requirements should be checked with the original equipment manufacturer before procurement and delivery of the equipment, in order that changes to the installation can be undertaken, if required.

8.104 A special challenge exists for the provision of clean electrical supplies and earth provision to ultrasound units for the following reasons:

- the majority of imaging transducers supplied with the base unit will use the earth as a reference value when being used for imaging purposes. Any contamination of the earth may cause the ultrasound equipment to become unreliable or cause degradation in diagnostic imaging performance. For example, ultrasound units may be susceptible to spikes and surges on the earth circuit that may be created when the energy from uncompleted X-ray fluorographic exposures is ‘dumped’ to a common earth circuit. The earth circuit for ultrasound units should be separated from those provided for X-ray units, so each ultrasound room should be fitted with a common earth reference terminal as specified in TRS89 (Medical Devices Agency). All

power outlets or sockets in the ultrasound room should be connected to this common earth, to minimise the risks of electrical potentials developing between different items of equipment attached to the patient;

- as for radio-nuclide imaging systems, the electrical supplies to the ultrasound unit should be provided using a different supply from the transformer to items of equipment that may generate transient high loads, as this may cause failure of the equipment or unreliability. A single uninterruptible power supply (UPS) may be installed within a conveniently located and well ventilated electrical cupboard or riser, possibly to serve all relevant equipment, including computers and ultrasound units. Alternatively, separate units could be provided for individual ultrasound units. Dedicated outlets for use with ultrasound machines should be labelled appropriately throughout the ultrasound cluster of units.

8.105 The above may be considered within a wider risk control strategy to provide either a continuous or core hours only ultrasound imaging service.

Emergency electrical supplies

8.106 The requirement to maintain a continuous imaging service during a power failure will depend on local circumstances and the reliance on ultrasound to provide a modern diagnostic imaging service. The provision of UPS devices should ensure that the units do not fail during the transient phase before any emergency generator is brought into service.

8.107 Where an ultrasound unit is used to undertake interventional procedures, the power to the unit will need to be maintained to allow the clinician to complete the procedure or bring it to a satisfactory conclusion without subjecting the patient to undue risk.

9. Appendices

Appendix 1

Glossary

Accident and Emergency Department (A&E): A hospital department specialising in the initial assessment and treatment of sudden illness or accident.

ACE inhibitors: Angiotensin converting enzyme inhibitors. A class of drug that reduces blood pressure and improves the function of the heart muscle by inhibiting the action of certain circulating hormones (angiotensins) which are raised in heart failure.

Acute myocardial infarction: Heart attack. Refers to the death of heart muscle (myocardium) which follows sudden reduction in or cessation of the flow of blood down the coronary arteries, e.g. narrowing due to atheroma of the vessels, leading to thrombosis in the coronary arteries.

Advanced life support: Attempt to restore spontaneous circulation following cardiac arrest using basic life support, defibrillation, advanced airway management and drugs.

Angina, angina pectoris: Literally pain in the chest. Usually gripping or crushing in nature in the chest and/or left arm and jaw felt when there is insufficient blood supply to the heart muscle.

Stable angina: is the term used for angina (pectoris) which is relatively predictable and the intensity and frequency of which remains similar over long periods

Unstable angina: is angina (pectoris) which is severe and unpredictable and which threatens to progress to an acute myocardial infarction.

Angiogram: A procedure in which a fine catheter is inserted via a blood vessel to inject x-ray opaque dye into the coronary arteries to obtain an x-ray image of the anatomy of the coronary arteries.

Angioplasty: A procedure in which a small balloon on the end of a catheter is inserted into an artery (in CHD the coronary arteries) and inflated to widen a narrowed artery.

Anti-emetic: A drug administered to relieve nausea and vomiting.

Anti-ischaemics: Drugs administered to treat angina by reducing the heart's workload and improve coronary blood supply, e.g. nitrates, beta-blockers and calcium antagonists.

Anti-thrombotics: Drugs administered to reduce blood clotting, e.g. aspirin, heparin.

Arrhythmia: An abnormal rhythm of the heart.

Artery: A blood vessel that carries blood away from the heart.

Atheroma: Deposits of fatty material and cholesterol inside the walls of arteries.

Atherosclerosis: Narrowing and thickening of arteries due to the development of fibrous tissue in the wall and sometimes calcium deposits. Usually associated with atheroma.

Atrial fibrillation: Irregular electrical activity in the atria (the receiving chambers of the heart) leading to irregular contraction of the heart muscle.

Beta-blocker: A class of drugs used to treat raised blood pressure and slow the heart rate by reducing adrenergic stimuli.

CABG: Coronary artery bypass grafting. An open-heart operation in which blockages to the coronary arteries are bypassed by grafting on a length of artery or vein to bring a fresh blood supply to the heart muscle.

Cardiac arrest: Complete cessation of the heartbeat.

Cardio-pulmonary resuscitation (CPR): The techniques of treating arrest of the heart by artificial respiration and cardiac compression.

Cardiothoracic: Of the heart and chest contents e.g. oesophagus and lungs.

Cardioversion: The application of electric shock or drugs to attempt restoration of a normal heart rhythm in a patient with cardiac arrhythmia.

Catheter, cardiac: A long, narrow tube which, when passed through the veins or arteries into the heart cavities is used for measuring pressures or injecting x-ray opaque dye for outlining the heart and blood vessels.

Catheterisation laboratory: The x-ray laboratory in which an angiogram is performed.

Cerebro-vascular: Of the blood vessels and circulation to the brain.

Cholesterol: A substance found in many foods and in all cells. Most of the cholesterol in the body is manufactured in the liver. An important constituent of atheroma.

Community development programmes: Where the community sets its own agenda and decides for itself how to improve health, with professionals acting as facilitators.

Coronary angiogram: An angiogram of the coronary arteries.

Coronary arteries: The arteries that supply the heart muscle with blood.

Coronary heart disease: Narrowing or blockage of the coronary arteries by atheroma, leading to angina, coronary thrombosis or heart attack, heart failure, and/or sudden death.

Criterion based dispatch systems: Systems which permit the prioritisation of 999 calls by the ambulance service to ensure that the most serious conditions receive top priority.

Defibrillator: An instrument for delivering an electric shock in an attempt to terminate ventricular fibrillation.

Electrocardiogram (ECG): A recording of the heart's electrical activity obtained from electrodes positioned on the chest wall and limbs. An exercise (stress) ECG is taken before and during exercise (usually using a treadmill or stationary bicycle) to obtain objective and quantitative recording of myocardial ischaemia on exertion.

Echocardiogram: An image and measurement of the heart obtained using ultrasound.

Embolism: The migration through the bloodstream of a blood clot from one part of the body to another where it causes an occlusion.

Fibrillation: Fast, irregular, electrical activity leading to fast irregular beating of the atria or ventricles.

Heart failure: A condition in which the pumping action of the heart is inadequate. It can result in the accumulation of fluid in the body and/or congestion of the lungs.

High density lipoprotein: A complex of fat and protein that may serve to remove cholesterol from the tissues. Sometimes described as the 'good' form of cholesterol.

Hypercholesterolaemia: Raised levels of cholesterol in the blood.

Hypertension: Raised blood pressure.

Infarction: Death of tissue following interruption of the blood supply.

Ischaemia: Blood supply inadequate for tissue needs especially during exercise.

Left ventricular dysfunction: Disordered pumping action of the main chamber of the heart.

Likelihood ratio: The likelihood that a given test result would be expected in a patient with the target disorder compared to the likelihood that the same result would be expected in a patient without that disorder.

Low density lipoprotein: A complex of fat and protein which is associated with an increased risk of coronary disease.

NHS 24: Nurse-led telephone helpline provided by NHSScotland

Nicotine Replacement Therapy (NRT): Nicotine supplied in the form of chewing gum, patches etc. to reduce craving for nicotine in people attempting to give up smoking.

Non-Q-wave infarction: An ECG manifestation of myocardial infarction where no pathological 'q' waves are present.

Occlusion: Blockage

Perfusionist: Specially trained staff who manage the heart-lung bypass equipment used during open-heart surgery.

Plaque: A deposit of atheroma.

Primary care: The conventional first point of contact between a patient and the National Health Service.

Primary prevention: The prevention of the development of a condition e.g. CHD, by avoidance of factors known to contribute to its development e.g. smoking, lack of exercise. See also secondary prevention.

Protocols: A plan detailing the steps that will be taken in the treatment of a patient or in a research study.

Percutaneous transluminal coronary angioplasty (PTCA): Angioplasty of the coronary arteries, i.e. the introduction of a balloon on a catheter through the skin (percutaneous), into a blood vessel (transluminal) and into the coronary arteries to widen them.

Pulmonary oedema: Congestion of the lungs associated with heart failure

Q-wave infarcts: An ECG manifestation of myocardial infarction where 'q' waves are present.

Refractory angina: Angina that persists despite anti-ischaemic medication and/or revascularisation

Revascularisation: A procedure to improve the blood supply. In the case of CHD these include CABG and PTCA.

Saturated fat: A form of fat which, when consumed, increases the blood cholesterol; found mainly in meat and dairy products.

Secondary prevention: In the case of CHD, interventions such as lifestyle changes or drugs aimed at slowing or reversing the progression of disease.

Sensitivity: The proportion of people with disease who have a positive test.

Specificity: The proportion of people free of a disease who have a negative test.

Statins: A class of drugs used to treat raised blood cholesterol and reduce the risk of CHD.

Stent: An artificial structure inserted into a coronary artery following PTCA to support the vessel wall and reduce the risk of re-occlusion.

Tachycardia: A heart rate of 100 beats per minute or greater.

Tertiary centre: A major medical centre providing open-heart surgery and PTCA, which receives referrals from both primary and secondary care.

Thrombolysis: The lysis (dissolving) of blood clots by the use of thrombolytic drugs.

Thrombolytic therapy: A class of drugs used to achieve thrombolysis.

Thrombosis: The process of clot formation (thrombus – clot).

Troponin-T: A protein released by injured heart muscle. Increasingly used to estimate risk of complications in people with heart attack or unstable angina.

Unstable angina pectoris: Angina which threatens progression to heart attack.

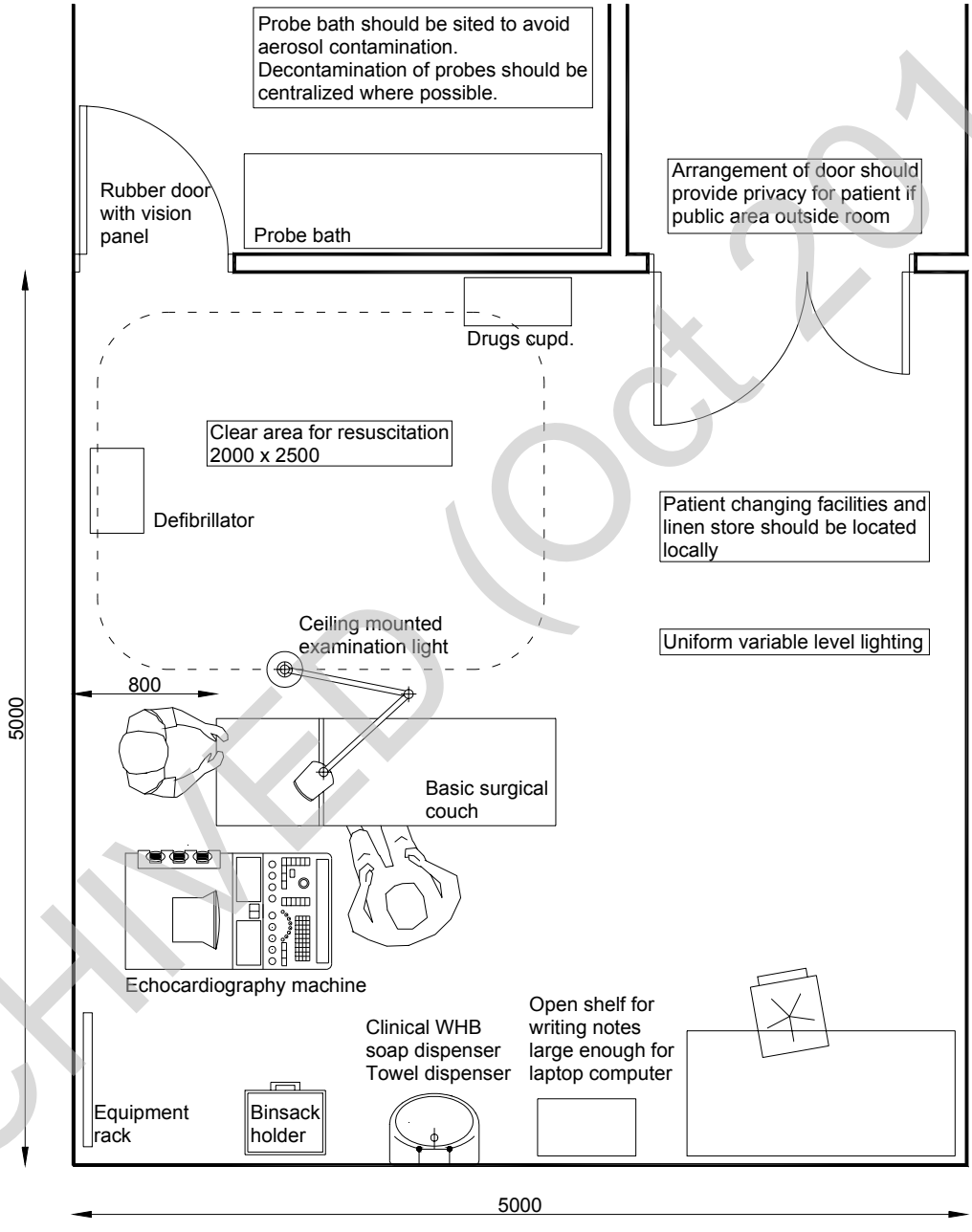
Ventricles: The two main pumping chambers of the heart.

Ventricular fibrillation: Rapid and chaotic beating of the ventricles caused by irregular electrical activity. The most common cause of cardiac arrest and death associated with myocardial infarction.

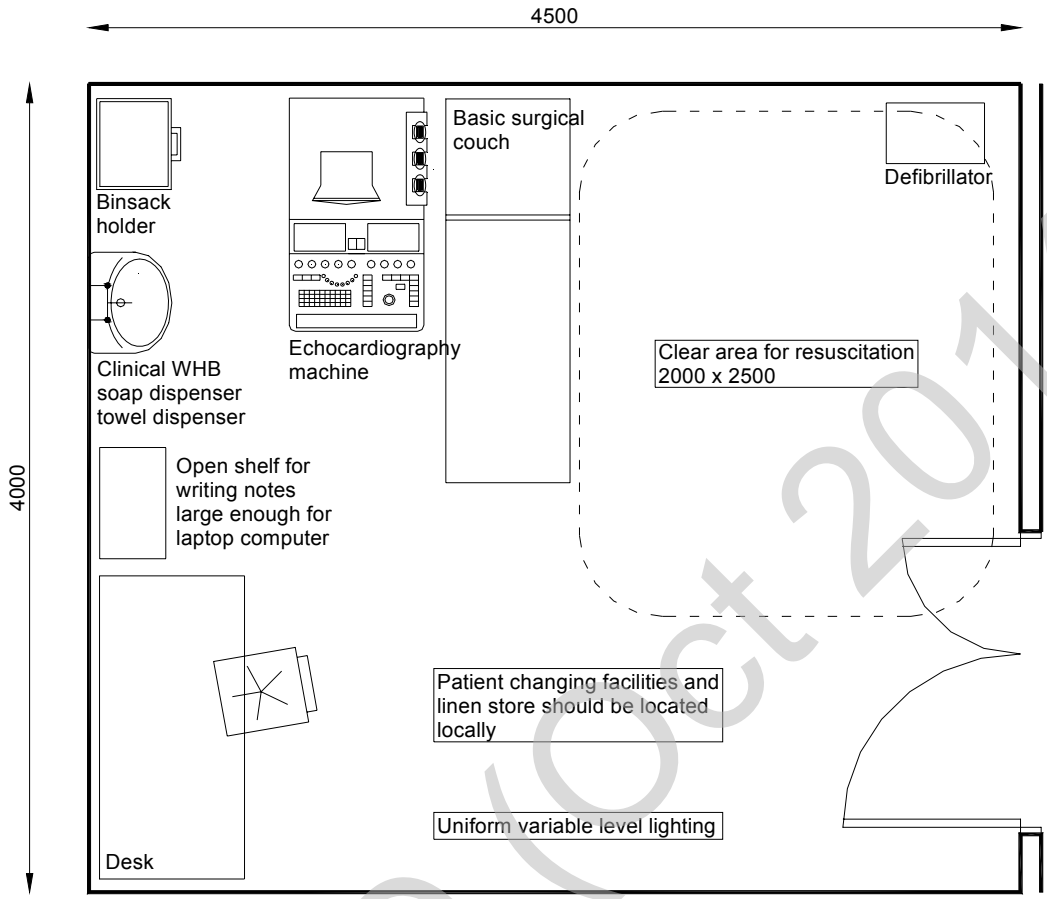
Warfarin: A drug used to treat blood clots.

Appendix 2

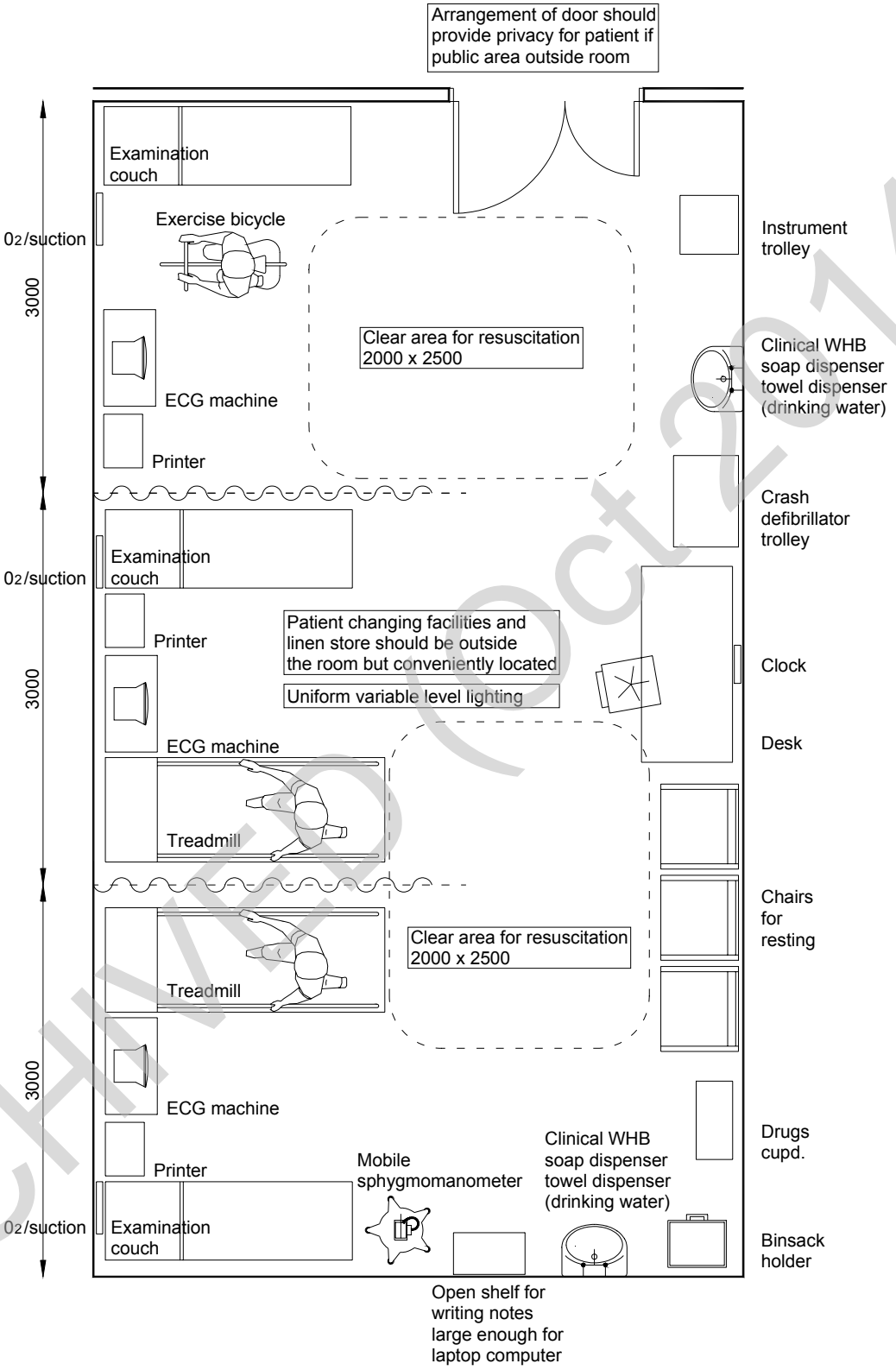
Room layouts



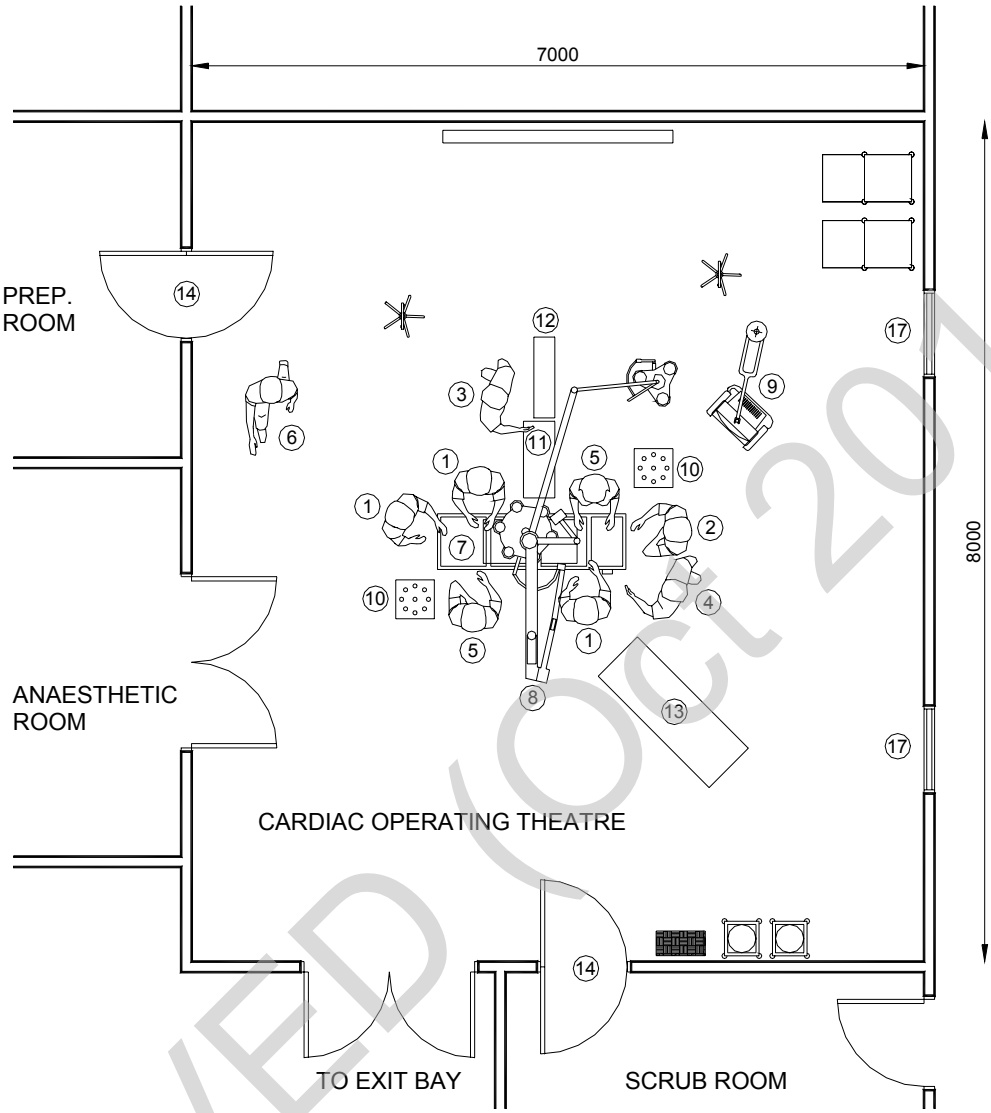
Echocardiography room (for use with oesophageal probe)



Echocardiography room (for use without oesophageal probe)



Exercise stress ECG room



STAFF

1. Consultant
2. Anaesthetist
3. Perfusionist
4. ODA
5. Scrub nurse
6. Running nurse

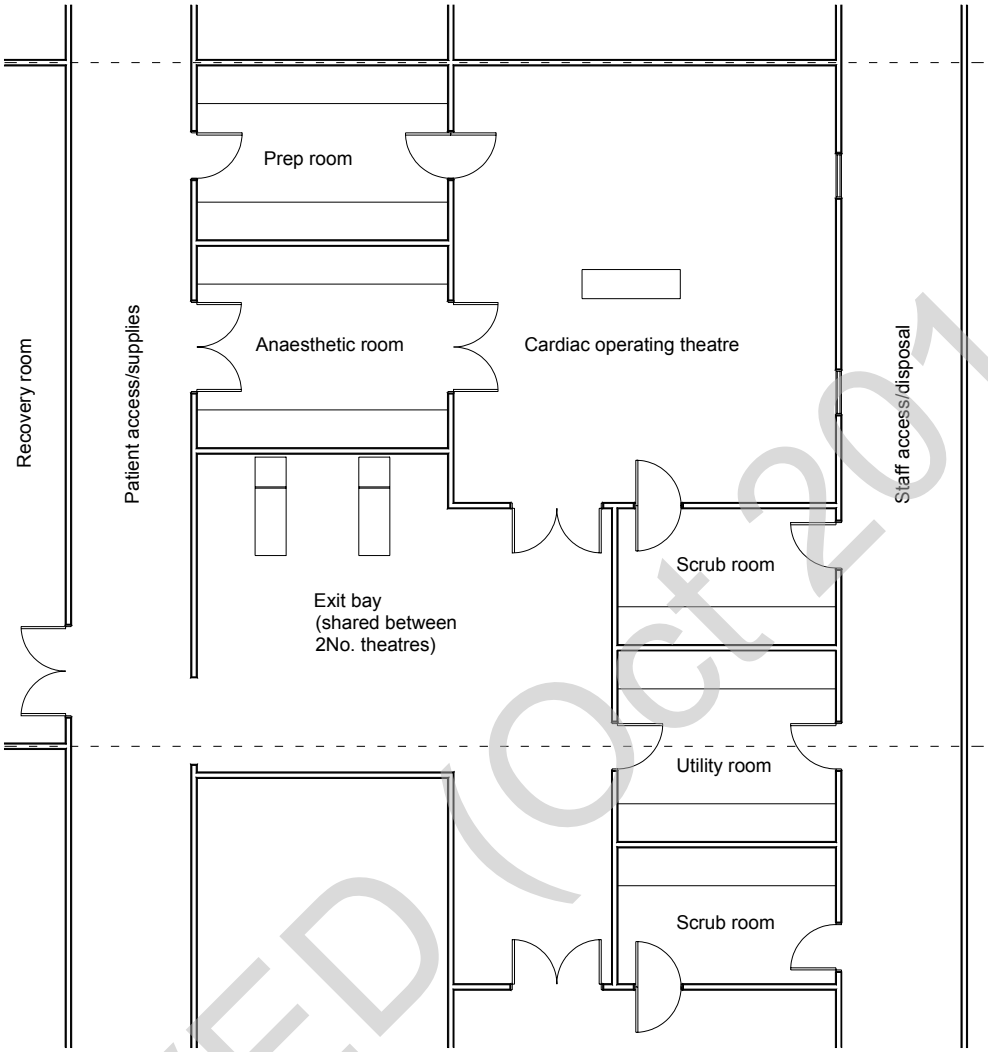
EQUIPMENT

7. Operating table
8. Operating light with video camera
9. Monitor nest - ceiling mounted
10. Pendant
11. Bypass machine
12. Floor mounted power supply for Bypass machine
13. Operating microscope (occasionally used)
14. Rubber door with vision panel

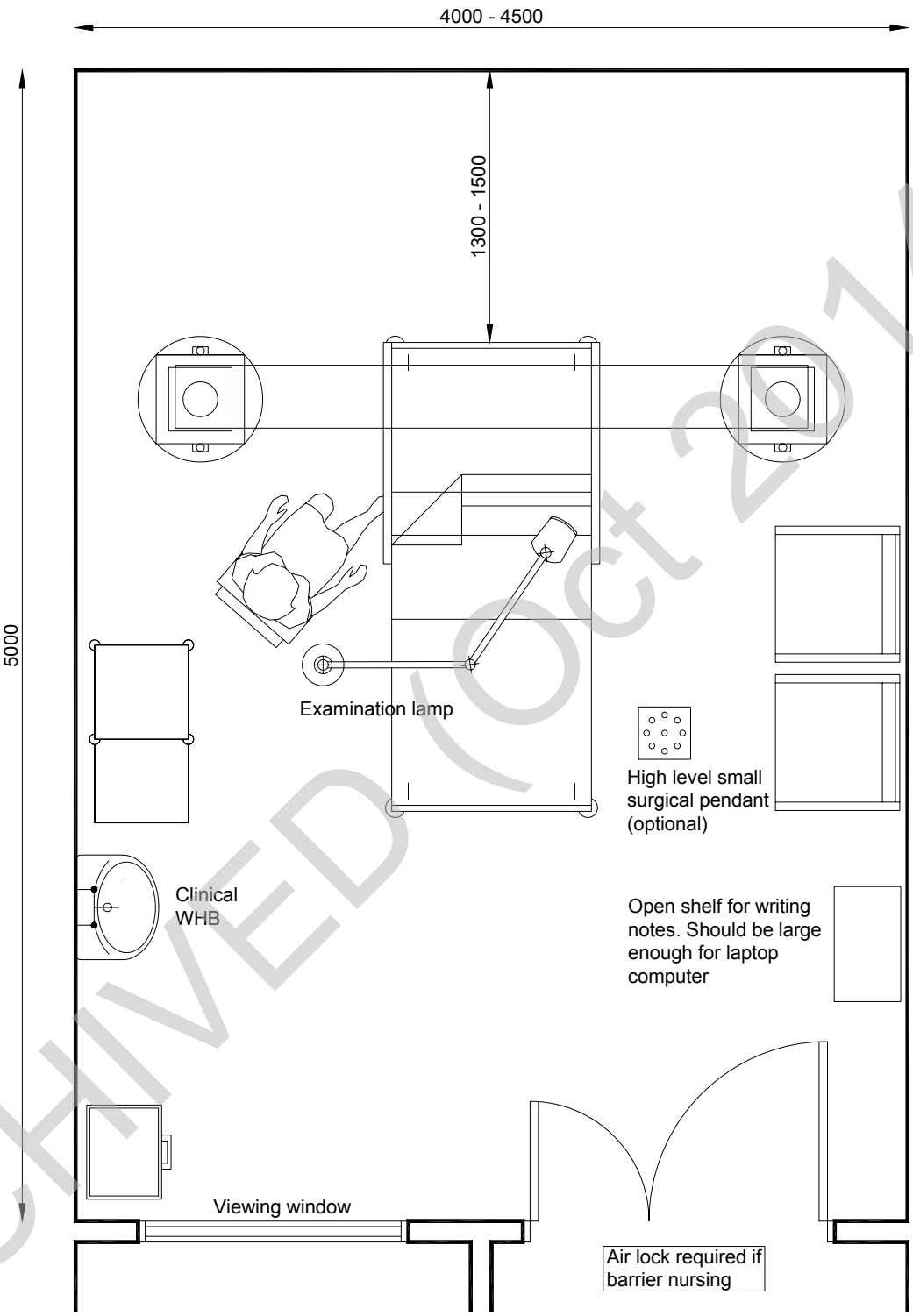
NOTES

15. Surgical trollies and some minor items of equipment for clarity
16. Storage for operating microcope should be provided outside operating theatre
17. Pressure relief dampers should be arranged to avoid views in from public spaces

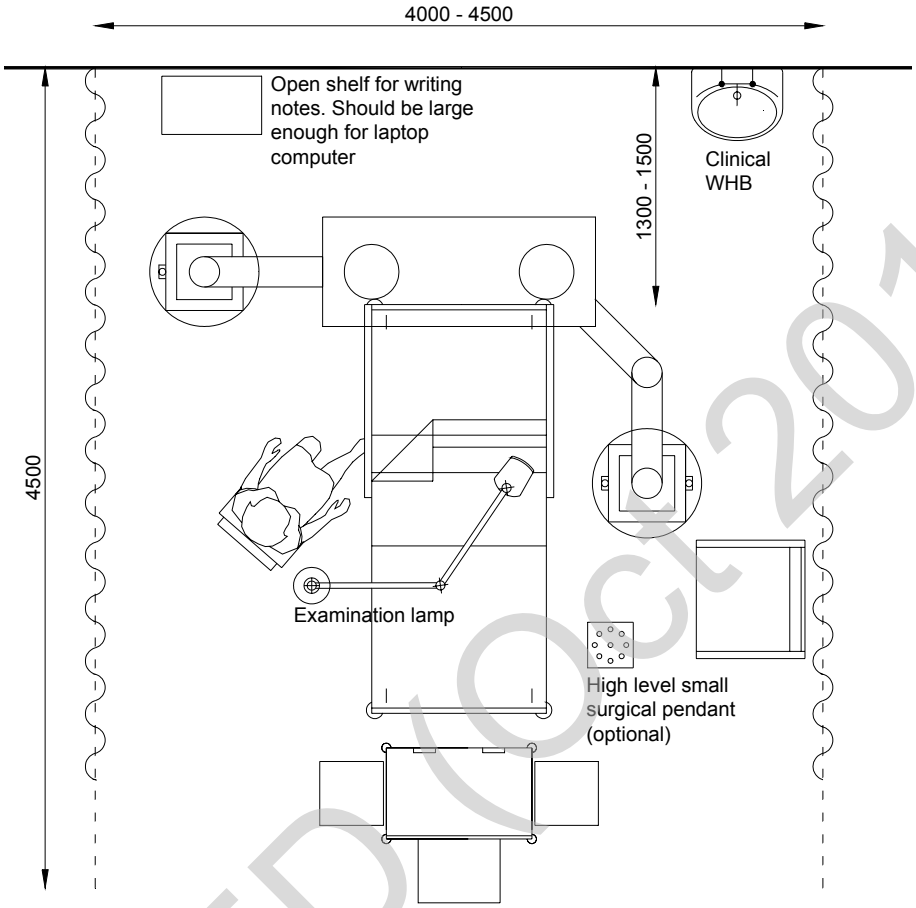
Cardiac operating theatre



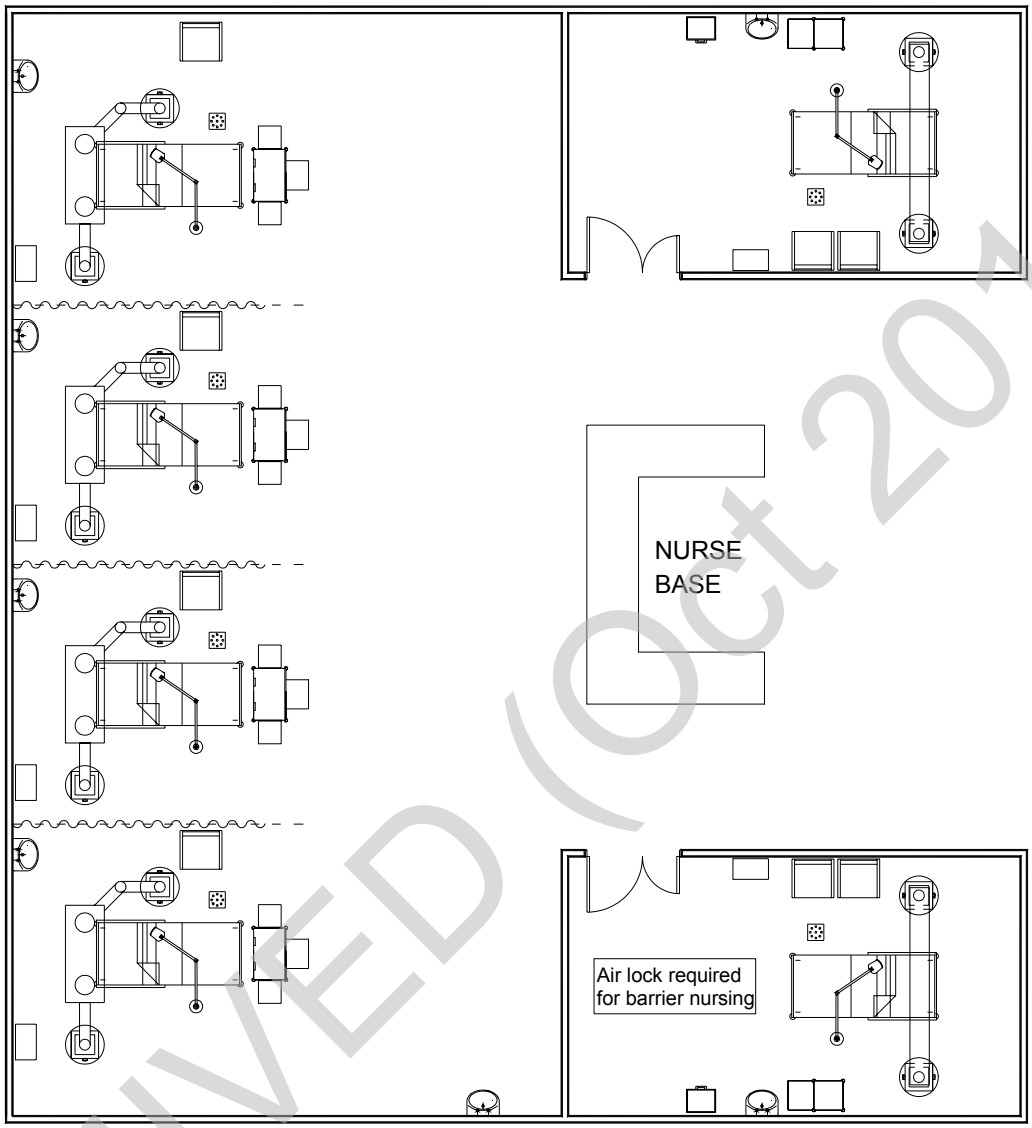
Cardiac operating suite



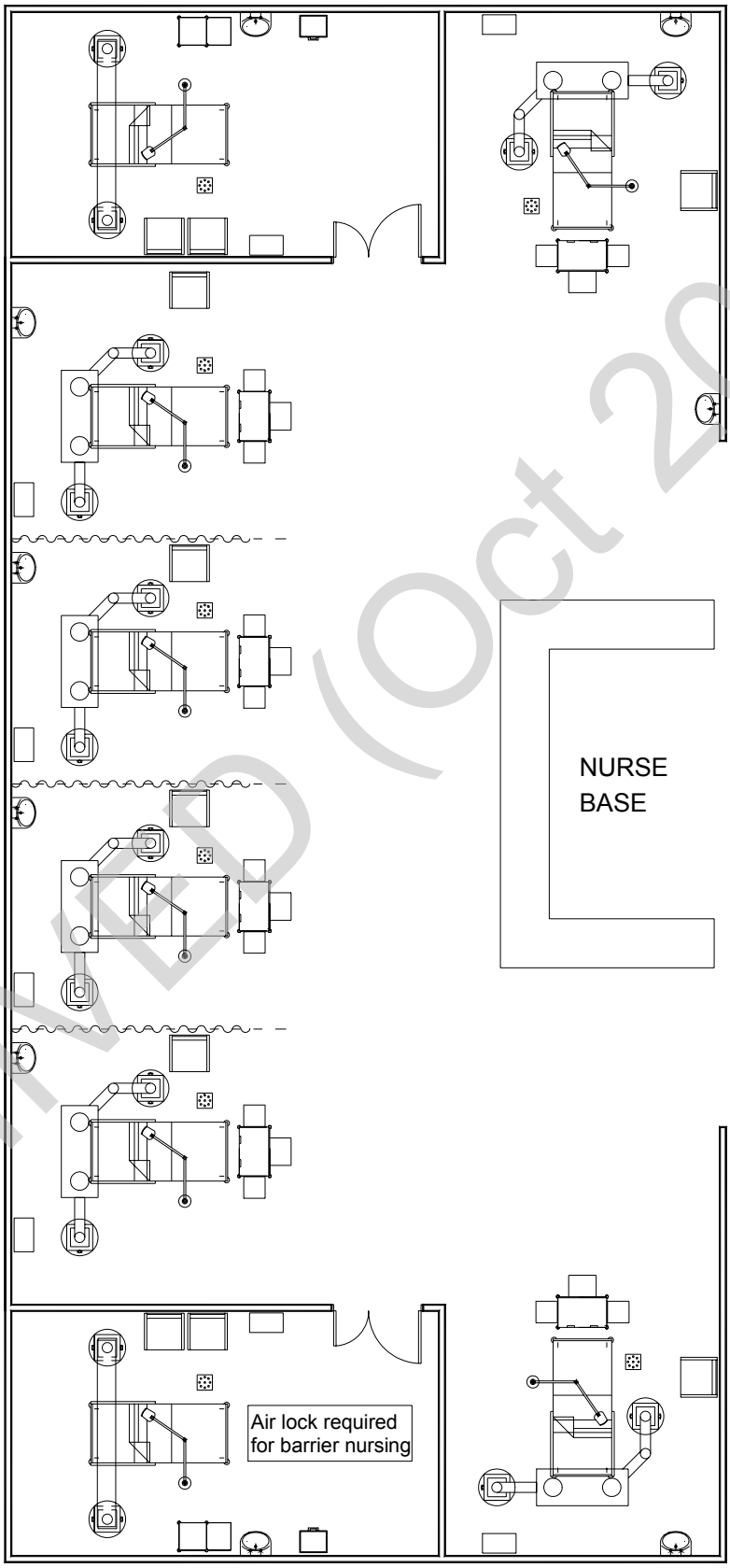
ITU single room



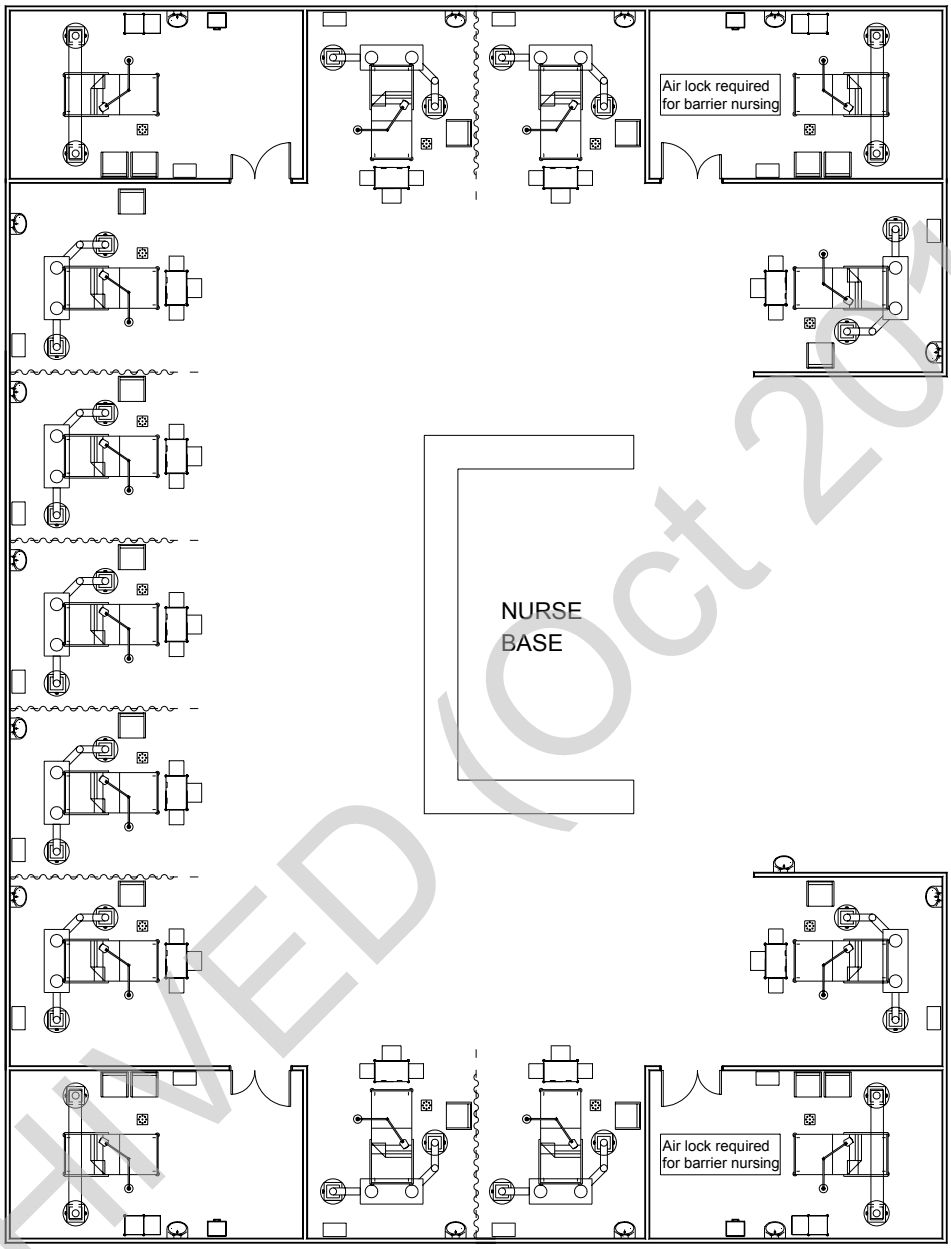
ITU single bay



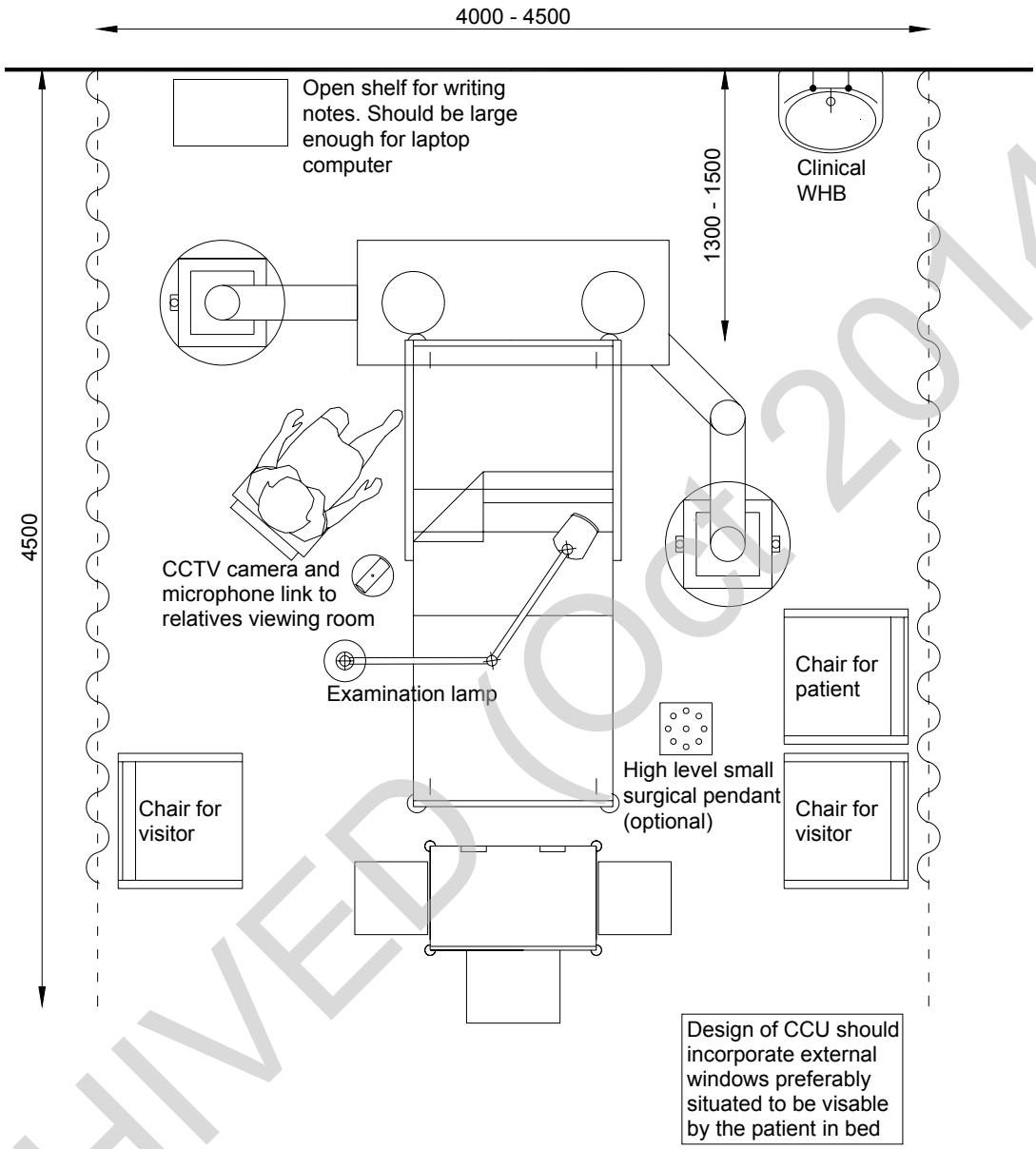
ITU six bed



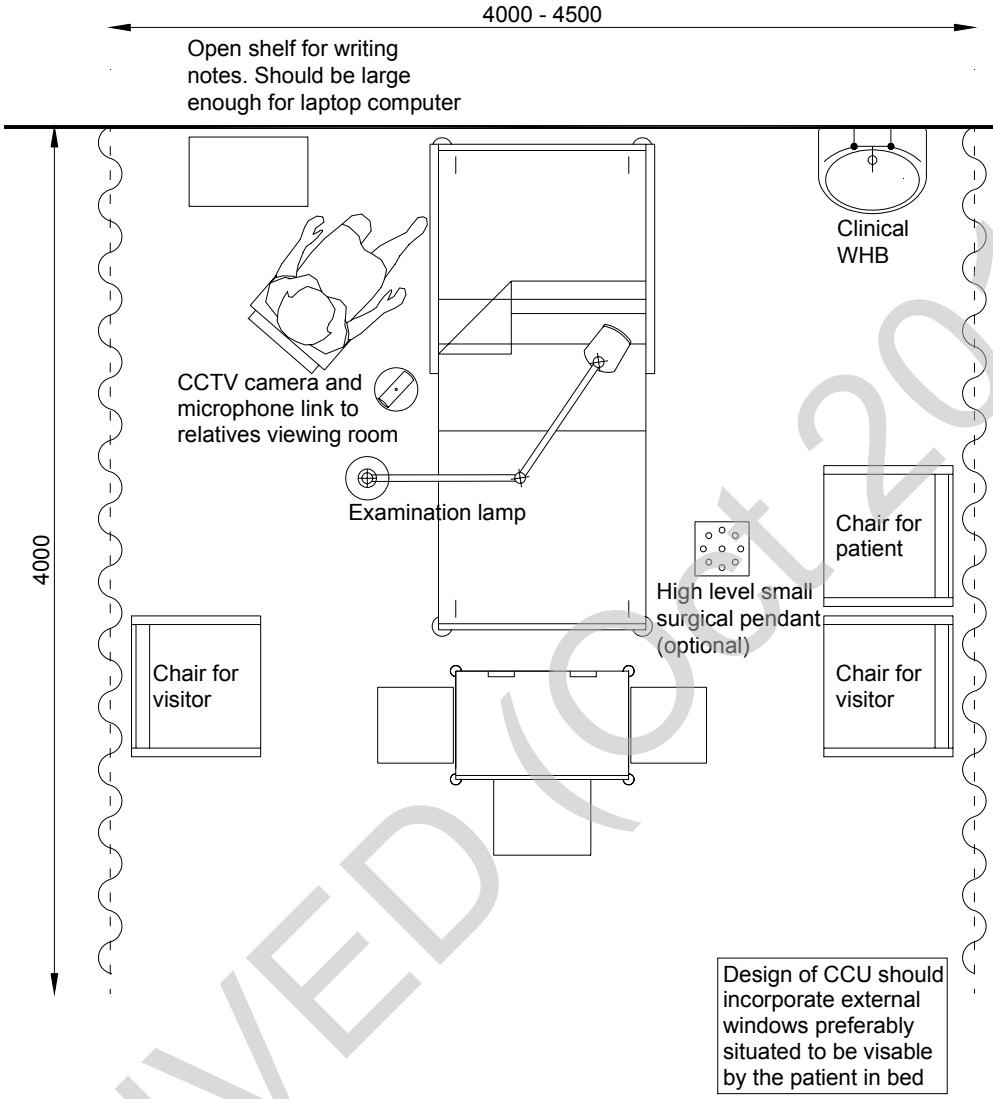
ITU eight bed



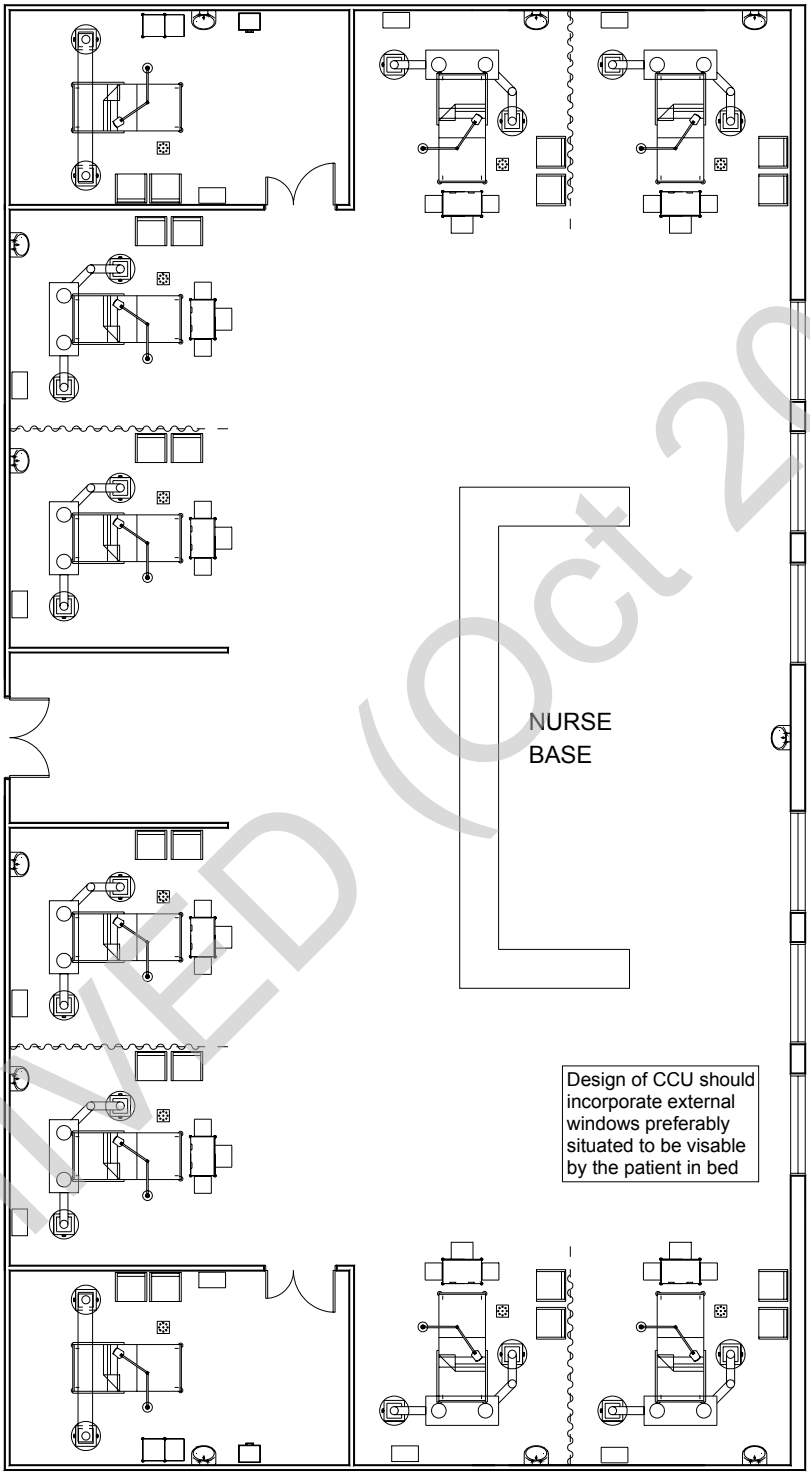
ITU fifteen bed



CCU single bay with gantry



CCU single bay without gantry



CCU ten bed

Appendix 3:

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