

STATUS IN NHSSCOTLAND  
**BEST PRACTICE GUIDANCE**

**Health Building Note 02-01**

**Cancer treatment facilities**

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This document must be read in conjunction with current Scottish Government Policy and NHSScotland Guidance, which take precedence. These include publications in both: [www.sehd.scot.nhs.uk/](http://www.sehd.scot.nhs.uk/) and [www.hfs.scot.nhs.uk/publications/](http://www.hfs.scot.nhs.uk/publications/).

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# Health Building Note 02-01: Cancer treatment facilities



# Health Building Note 02-01

## Cancer treatment facilities

*Front cover: Treatment area, Wigan Renal Unit*

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# Preface

## About Health Building Notes

Health Building Notes give “best practice” guidance on the design and planning of new healthcare buildings and on the adaptation/extension of existing facilities.

They provide information to support the briefing and design processes for individual projects in the NHS building programme.

## The Health Building Note suite

Healthcare delivery is constantly changing, and so too are the boundaries between primary, secondary and tertiary care. The focus now is on delivering healthcare closer to people’s homes.

The Health Building Note framework (shown below) is based on the patient’s experience across the spectrum of care from home to healthcare setting and back, using the national service frameworks (NSFs) as a model.

## Health Building Note structure

The Health Building Notes have been organised into a suite of 17 core subjects.

**Care-group-based** Health Building Notes provide information about a specific care group or pathway but cross-refer to Health Building Notes on **generic (clinical) activities** or **support systems** as appropriate.

Core subjects are subdivided into specific topics and classified by a two-digit suffix (-01, -02 etc), and may be further subdivided into Supplements A, B etc.

All Health Building Notes are supported by the overarching Health Building Note 00 in which the key areas of design and building are dealt with.

### Example

The Health Building Note on accommodation for adult in-patients is represented as follows:

“Health Building Note 04-01: Adult in-patient facilities”

The supplement to Health Building Note 04-01 on isolation facilities is represented as follows:

“Health Building Note 04-01: Supplement 1 – Isolation facilities for infectious patients in acute settings”

Health Building Note number and series title	Type of Health Building Note
Health Building Note 00 – Core elements	Support-system-based
Health Building Note 01 – Cardiac care	Care-group-based
Health Building Note 02 – Cancer care	Care-group-based
Health Building Note 03 – Mental health	Care-group-based
Health Building Note 04 – In-patient care	Generic-activity-based
Health Building Note 05 – Older people	Care-group-based
Health Building Note 06 – Diagnostics	Generic-activity-based
Health Building Note 07 – Renal care	Care-group-based
Health Building Note 08 – Long-term conditions/long-stay care	Care-group-based
Health Building Note 09 – Children, young people and maternity services	Care-group-based
Health Building Note 10 – Surgery	Generic-activity-based
Health Building Note 11 – Community care	Generic-activity-based
Health Building Note 12 – Out-patient care	Generic-activity-based
Health Building Note 13 – Decontamination	Support-system-based
Health Building Note 14 – Medicines management	Support-system-based
Health Building Note 15 – Emergency care	Care-group-based
Health Building Note 16 – Pathology	Support-system-based

## Other resources in the DH Estates and Facilities knowledge series

### Health Technical Memoranda

Health Technical Memoranda give comprehensive advice and guidance on the design, installation and operation of specialised building and engineering technology used in the delivery of healthcare (for example medical gas pipeline systems, and ventilation systems).

They are applicable to new and existing sites, and are for use at various stages during the inception, design, construction, refurbishment and maintenance of a building.

All Health Building Notes should be read in conjunction with the relevant parts of the Health Technical Memorandum series.

### Activity DataBase (ADB)

The Activity DataBase (ADB) data and software assists project teams with the briefing and design of the healthcare environment. Data is based on guidance given in the Health Building Notes, Health Technical Memoranda and Health Technical Memorandum Building Component series.

1. Room data sheets provide an activity-based approach to building design and include data on personnel, planning relationships, environmental considerations, design character, space requirements and graphical layouts.
2. Schedules of equipment/components are included for each room, which may be grouped into ergonomically arranged assemblies.
3. Schedules of equipment can also be obtained at department and project level.
4. Fully loaded drawings may be produced from the database.
5. Reference data is supplied with ADB that may be adapted and modified to suit the users' project-specific needs.

### Note

The sequence of numbering within each subject area does not necessarily indicate the order in which the Health Building Notes were or will be published/printed. However, the overall structure/number format will be maintained as described.

# Executive summary

This Health Building Note covers the policy and service context, and planning and design considerations, for cancer treatment facilities.

It covers specific planning and design considerations for chemotherapy and radiotherapy units. It describes spaces that are unique to those units. It also describes any variations to common hospital spaces and clarifies requirements for these spaces, where necessary.

For a full list of space components, see the example schedules of accommodation for a chemotherapy unit serving a population of 400,000 and for a two and four-linear accelerator radiotherapy unit. Links to guidance on common spaces are provided from the example schedules.

## Key changes since Health Building Note 54 (2006)

The major differences in ‘Cancer treatment facilities’ compared with Health Building Note (HBN) 54 (2006) are:

- 1 A dedicated cancer out-patients department is no longer included, as it is assumed that the same functions can take place within a general out-patients department, within either a hospital or a primary care setting.
- 2 A suite of entrance facilities is not included, as it is assumed that patients attending the chemotherapy and radiotherapy units would use the hospital’s main entrance facilities.
- 3 The guidance now includes the addition of radiotherapy medical physics and technology accommodation, with some specific core rooms, and some optional rooms depending on the proximity of the main medical physics department.
- 4 It also now includes an on-treatment review suite for both chemotherapy and radiotherapy (two separate areas). This provides clinicians with appropriate facilities for reviewing patients at the same time as they attend for their treatment.
- 5 It is assumed that radiotherapy units will be accommodating radiotherapy equipment with an output of no more than 15 MV, as this was felt by the expert group to be the likely maximum requirement. Units operating equipment at higher output levels than this are advised to seek specific advice on radiation protection requirements.
- 6 The guidance includes the superficial/orthovoltage radiotherapy treatment room only as optional provision.
- 7 It includes a facility associated with both imaging and treatment rooms for radiotherapists to undertake data preparation, calculations and image review in a separate area to the control areas – to provide a quiet, uninterrupted environment for this work to take place.
- 8 It assumes that staff will make use of shared central changing facilities and no longer includes local provision for staff changing (although this has been included as an optional facility).



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# 1 Policy context

## Background

- 1.1 The NHS Cancer Plan (DH, 2000), which set out the first-ever comprehensive strategy to tackle cancer, was updated in 2007 with the publication of the Cancer Reform Strategy.
- 1.2 More recently the Department of Health published 'Improving outcomes: a strategy for cancer' (January 2011), setting an aspirational challenge for the National Cancer Programme. In the context of the Government's reforms of the health service and changes to the provider, commissioning and public health agendas, the programme aims to save at least an additional 5000 lives in England each year by 2015, in order to equal the European average.
- 1.3 This assumes a level of awareness, presentation and early diagnosis that matches levels in the rest of Europe. However, earlier diagnosis is just the beginning of the picture. Our clinical facilities, treatment delivery and technology must also be capable of matching these aspirations.
- 1.4 Current reference documents for cancer services include those linked to in the sections below.

### Note

Policy is continually reviewed and updated. Readers are encouraged to ensure they are accessing the latest version of any documents referenced.

## Quality of environment

- 1.5 Project teams should seek the views of all users from the onset of the planning and design process.
- 1.6 Whatever the setting or basis of treatment delivery, the privacy, dignity and comfort of patients are key.
- 1.7 Important features of the environment include: external views and access to gardens where possible; positive distractions, for example with interesting artwork; the ability to control temperature locally (some patients are very sensitive to temperature),

especially in the treatment suites; control over noise and lighting; and control over privacy.

- 1.8 Project teams may wish to review the research literature available regarding colour schemes in chemotherapy facilities.
- 1.9 Macmillan Cancer Support is working hard to improve cancer care environments. It has developed the Macmillan Quality Environment Mark (MQEM), a national evidence-based benchmark for the patient experience in cancer facilities. All cancer services are recommended to adopt MQEM, either as part of their service improvement process or in the course of developing new facilities. See also: Macmillan Cancer Environments.

## Delivering same-sex accommodation

- 1.10 See 'Delivering same-sex accommodation' under 'Functional design issues' in Health Building Note 00-01. Guidance applying to generic recurring accommodation such as in-patient accommodation is included in the relevant topic.
- 1.11 Sometimes, patients who have frequent, short admissions – like patients undergoing chemotherapy – may prefer to be cared for with others with the same condition, irrespective of their gender. This is acceptable, as long as it is the decision of the whole group and does not adversely affect the care of others. It is not acceptable where the only justification is frequent admission, and there is no recognisable group identity. Nor is it acceptable where the main justification is organisational convenience. Further guidance is provided at [paragraph 9.22, 'Chemotherapy treatment suite'](#). See also 'Eliminating Mixed Sex Accommodation (PL/CNO/2010/3)'.

## 2 Diagnosis

- 2.1 Following an out-patient consultation, the patient will undergo investigations (usually imaging and pathology). They will then return to an out-patient setting for the results and to discuss possible treatment plans. Oncology out-patient facilities are assumed to form part of the general out-patients department, with generic rooms used on a sessional basis.
- 2.2 Diagnostic imaging/pathology services will usually be provided from a central facility.
- 2.3 Spaces will be required for multidisciplinary team meetings, which are an integral part of the pathway prior to patients returning for results. These meetings can take place within generic seminar/meeting rooms provided that there are suitable facilities for teleconferencing, accessing patient records and viewing PACS images and pathology slides, where necessary.
- 2.4 See Health Building Note 6 Vol 1, 'Facilities for diagnostic imaging and interventional radiology'; Health Building Note 15, 'Facilities for pathology services'.

## 3 Overview of treatment

- 3.1 An overall treatment strategy may involve surgery, chemotherapy and/or radiotherapy, alongside hormone therapy and tumour-suppressive drugs. Some patients may receive chemotherapy and radiotherapy concurrently. Where chemotherapy and radiotherapy facilities are provided from the same location, they should be co-located, for the patient's convenience and to enable efficient working practices. The working pattern of clinical oncologists means that they need to access both areas and their administration bases.
- 3.2 Chemotherapy and radiotherapy facilities are largely self-contained, and they require good access to the main diagnostic, surgical, in-patient, critical care, accident and emergency (A&E), and rehabilitation facilities, along with the main medical physics, pharmacy and pathology facilities.
- 3.3 Patient support services such as wig fitting and prostheses services, information services, and complementary therapies are essential. They may be provided from the general out-patient departments, ideally located close by; if not, provision should be made within the oncology unit itself.

## 4 Chemotherapy

- 4.1 Chemotherapy is the use of systemic anti-cancer (or cytotoxic) drugs that destroy cancer cells. The types of chemotherapy used will depend on a number of factors including where the cancer started (primary) and/or whether it has spread (secondary or metastatic).
- 4.2 It is being used increasingly widely, including in a wider range of solid cancers than previously, with new drugs being developed.
- 4.3 Patient-specific treatment protocols/regimens will be prescribed, and drugs may be given over a period of one or two weeks, or two or more drugs may be administered over a period of one day. A typical regimen may last over six months, with the patient returning at frequent intervals for treatment.
- 4.4 The drugs are usually given by the intravenous route, either as a bolus over minutes (on an out-patient basis) or as an infusion over hours (as a day case), but may be taken orally as a tablet or capsule. Some patients will be admitted for elective chemotherapy owing to the administration times/length of the regimen. These patients would receive their chemotherapy on the ward, whether bolus or infusion.
- 4.5 The patient will undergo regular imaging investigations and pathology tests to monitor the success of the treatment.
- 4.6 Post-chemotherapy supportive therapies may include the prescribing of anti-emetic drugs, which will require collection from a pharmacy facility located close by.

### Intrathecal chemotherapy

- 4.7 Compliance with HSC 2008/001 'Updated national guidance on the safe administration of intrathecal chemotherapy' requires that new or updated chemotherapy facilities include a "permanently designated area for intrathecal chemotherapy for trusts wishing to provide this service". It is recommended that this should take the form of a dedicated treatment room or rooms.
- 4.8 It is not desirable to store intrathecal chemotherapy drugs outside the pharmacy between issuing and administration, and emergency stocks should never be held on the ward. However, if the drugs have to be issued and there will be a short delay before administration, they should be stored in a dedicated container/refrigerator reserved for this purpose alone.
- 4.9 More detailed information is provided within Health Service Circular 2008/001 'Updated national guidance on the safe administration of intrathecal chemotherapy'.
- 4.10 See also Chapter 9, 'Chemotherapy unit'.

## 5 Radiotherapy

- 5.1 Radiotherapy is the use of ionising radiation to damage and kill diseased cells. Its main use is found in cancer treatment where it can be used on its own, with curative or palliative intent, or as part of a wider treatment of the cancer, which might also involve surgery or chemotherapy.
- 5.2 Radiation exposure can damage cell DNA and this can lead to the cell being unable to reproduce, or to cell death. Healthy cells are generally more able to repair this kind of damage than cancerous cells and, by splitting radiotherapy treatments into treatment fractions, it is possible to take advantage of this repair mechanism and inflict damage on the cancer while reducing the effect on healthy tissues. The precise fractionation of the radiotherapy is therefore a crucial part of the prescription.
- 5.3 Individual patient treatment plans are produced to enable the delivery of prescribed radiation doses to the disease. The planning process involves some form of imaging (usually a CT scan) and the outlining of various structures, such as the tumour and other organs, within the images. Certain organs, generally close to the tumour, are designated “organs at risk” (OARs) and need to receive low radiation doses to avoid long-term, undesirable side-effects. Radiotherapy treatments are always, then, a careful balance of clinical risk between the probability of controlling the tumour and the probability of causing harm to normal tissues.
- 5.4 Once a plan has been produced, approved and verified using further imaging, the patient can receive treatment.
- Radiotherapy staff groups**
- 5.5 Doctors, physicists, dosimetrists, radiographers and technologists are all required to work together to provide high-quality radiotherapy treatment.
- 5.6 **Clinical oncologists** ... take overall responsibility for the patient’s treatment. They are involved in diagnosing and determining the staging of the cancer, deciding on a course of treatment and prescribing the radiation dose. The process of prescribing is complicated and involves the definition of the target volume as well as determining the radiation dose to be delivered.
- 5.7 **Physicists** ... develop and oversee the scientific infrastructure of the oncology centre. They are responsible for ensuring the proper commissioning and calibration of radiation-producing equipment and the safe use of radiation, protecting the patients, staff and members of the public in compliance with the relevant legislation.
- 5.8 **Dosimetrists** ... plan radiotherapy treatments based on the requirements of the oncologist. They require good knowledge of human anatomy and equipment capabilities to produce practical, successful treatment plans. Dosimetrists also check radiotherapy plans and help with the development of new types of treatment.
- 5.9 **Radiographers** ... take the patient through the treatment process. Radiographers are involved in scanning the patient before the treatment plans are created and in producing an accurate daily patient set-up on the day of treatment. They operate the therapy equipment to deliver the radiation dose and have an important role in providing advice and counselling for the patient and their family.
- 5.10 **Clinical technologists** ... provide on-site technical expertise for radiotherapy equipment. Technicians carry out repair work on the machines as well as doing routine maintenance to prevent breakdowns. They also carry out aspects of equipment quality assurance.
- 5.11 **Nursing staff** ... provide support to patients and on-treatment reviews, where they may assess patients and prescribe supportive drugs to reduce treatment toxicities.
- 5.12 See also Chapter 10, ‘Radiotherapy unit’.

## Teletherapy

- 5.13 This is the most frequently used form of radiotherapy. A radiation beam is generated by a machine source of radiation external to the patient and at a distance from the body. The two most important characteristics of treatment are:
- the localisation of the beam to the target volume; and
  - the level of dose deposited in the tumour. In the planning process, radiation beams/sources are simulated in order to calculate and assess the optimum treatment geometry and dose delivery by the radiation.
- 5.14 Patients usually attend the radiotherapy unit on an out-/day-patient basis, or they may attend as an in-patient coming from the ward to receive their treatment. Teletherapy is delivered by large machines (usually linear accelerators) situated within shielded facilities with very particular requirements, as described below.

### Linear accelerators (linacs)

- 5.15 The linear accelerator is the primary and mostly widely used treatment unit for radiotherapy (teletherapy). Radiation beams are produced by accelerating electrons to very high energies and, depending on the type of radiation beam required, directing the accelerated electrons onto a metal target.
- 5.16 The radiation beams are shaped by collimators<sup>1</sup> or applicators in the linac head in order to direct precisely defined radiation fields into the target volume within the patient. The linac measures the radiation output in order to deliver precisely determined radiation doses.
- 5.17 This guidance assumes the provision of linacs operating at up to 15 MV; units deciding to operate linacs above this output should obtain specialist advice, as additional radiation protection considerations will be required.

### Image-guided radiotherapy (IGRT)

- 5.18 Image-guided radiotherapy achieves localisation of the beam to within the target volume by imaging the patient once they are on the treatment couch in the treatment position. This means that if the

tumour has moved since the previous treatment, the patient can be repositioned so that the radiation targeting is improved.

- 5.19 IGRT can potentially be implemented in a number of ways. The most commonly used method is to perform “cone-beam CT” scans by use of an X-ray tube and detector mounted onto the linac gantry. A comparison is made between the CT scan from the treatment planning process and the scan made with the patient on the treatment couch at treatment delivery. A decision can then be made about whether the patient position should be adjusted.

### Intensity-modulated radiotherapy (IMRT)

- 5.20 Conventional radiotherapy is often limited in terms of its ability to avoid certain organs and to deposit the dose within the confined tumour region. Intensity-modulated radiotherapy is a way of improving these abilities by creating radiation fields with varying intensities. Different methods are used by linac manufacturers to achieve these intensity-modulated fields, such as “step-and-shoot”, where individual “beamlets” are created by the MLC in sequence, or “sliding window”, where the MLC moves across the field throughout treatment to vary the beam intensity.
- 5.21 While the technical performance of modern linear accelerators is such that IMRT is achievable, the challenge often lies in producing the treatment plans. Instead of manually changing dose contributions from each beam, new planning software can “optimise” beam arrangements and dose contributions to give the best possible dose distributions (“inverse planning”). A balance is often required between the dose delivered to critical organs and that delivered to the target volume. IGRT is an essential part of IMRT as sharper dose gradients are used, requiring more accurate positioning.

### Rotational IMRT

- 5.22 IMRT can be performed either with the linac gantry at fixed angles or by treating while the gantry is rotated around the patient. Often, two or more rotations of the gantry are required to give the desired dose distributions. Rotational IMRT can often be delivered with lower total monitor units than conventional IMRT and tends to deliver lower doses to volumes outside the target organ.
- 5.23 Tomotherapy is another rotational IMRT solution; unlike conventional linacs, it is designed to perform

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<sup>1</sup> Modern linacs are fitted with multi-leaf collimators (MLCs), which are able to define customisable field shapes, usually to within tenths of a millimetre.

only rotational IMRT. Tomotherapy does not use MLCs but has a series of shutters which can open and close very quickly. As the radiation beam is rotated around the patient, these shutters are used to shield parts of the patient, so creating dose distributions which can be designed to conform tightly to the treatment regions.

### Stereotactic radiotherapy/radiosurgery

- 5.24 Stereotactic radiosurgery (a single fraction treatment) and radiotherapy (more than one fraction) deliver an ablative (or destructive) dose of radiation to a small target volume. The doses delivered per fraction are significantly larger than a conventional radiotherapy treatment, but the total biologically effective dose over the course of treatment is generally the same. The aim is different from conventional radiotherapy and IMRT in that the radiation dose per fraction is sufficient to destroy, rather than to damage, tumour cells. Suitable tumour targets tend to be very small, and many beams are used to maximise the dose delivered to the tumour while minimising high-dose delivery to healthy tissues.
- 5.25 The high doses per fraction mean that geometric precision is extremely important. IGRT therefore plays a very important role in radiosurgery in making sure that the tumour is properly targeted. In regions where the target might be moving (that is, in the lungs, abdomen etc), techniques such as gating or chest compression are often employed to achieve superior targeting.
- 5.26 There are many stereotactic delivery systems available, including conventional linear accelerators. While linacs can be used to perform radiosurgery, other pieces of equipment are increasingly being specifically designed for this purpose. Robotic radiosurgery can be performed with a linear accelerator attached to a robotic arm. The patient is positioned either sitting or lying down while the arm moves around, exposing the patient to many small beamlets (hundreds per treatment). It makes use of a number of imaging techniques to locate the tumour throughout treatment, including respiratory and bone anatomy tracking.

### Brachytherapy

- 5.27 This is internally delivered radiotherapy where a radioactive source is positioned in the patient's body, inside or next to the tumour, either

permanently or temporarily. This can be advantageous in some clinical cases as the radiation dose is more restricted to a short distance from the source and can reduce the irradiation of normal tissue. Patients attend as day case patients or are admitted as in-patients, depending on the type of treatment approach.

- 5.28 Brachytherapy is performed either by the insertion of radioactive wires and seeds directly into the tumour or, more commonly, by driving a single highly radioactive pellet down a transfer tube placed inside or next to the tumour. It is routinely used for gynaecological, prostate, breast and skin cancers. As an example of a modern development in breast brachytherapy, a small balloon and catheter can be inserted, intra-operatively, into the tumour excision site. A radioactive source is then driven into the centre of the balloon to treat the surrounding tissues.

### Temporary implants

- 5.29 Before temporary radioactive sources are placed in a patient's body, applicators or catheters have to be inserted into the patient, usually in a standard operating theatre. The patient is then taken on a trolley from the operating theatre to an imaging suite, where the applicator's/catheter's precise position and geometry is determined with respect to the patient's anatomy.
- 5.30 The patient is then transferred to the brachytherapy suite, which contains a shielded source container built into an after-loading machine. Within the shielded source container is a single, highly radioactive source, usually iridium-192. The applicators/catheters within the patient are connected to the after-loading machine via transfer tubes. Using a computer control unit, the radioactive source is then mechanically transferred to the applicators to deliver the treatment. At the end of the treatment, the applicators/catheters are removed from the patient.
- 5.31 Certain insertions may be undertaken in the brachytherapy suite, provided that it is suitably equipped for surgical procedures, including anaesthesia, and has suitable imaging facilities.

### High dose rate (HDR) brachytherapy

- 5.32 A single, highly active source of iridium-192 is transferred mechanically from the source container to the first applicator tube and stepped along the treatment length. It is then retracted and placed

into the next applicator. The dose required is delivered in a single treatment lasting typically 10 to 20 minutes.

#### *Pulsed dose rate (PDR) brachytherapy*

5.33 This is similar to high dose rate brachytherapy but the source is only a tenth of the activity of a high dose rate source, and instead of a single treatment lasting 10 to 20 minutes, several treatments are delivered, each lasting about 10 minutes and repeated at regular intervals for up to 48 hours. The patient remains within the brachytherapy suite, provided as a specialist facility within the in-patient accommodation, and requires nursing facilities.

#### **Permanent implants**

5.34 Small radioactive sources are inserted or implanted directly into the tissue in a standard operating theatre, although specialist equipment is required during the procedure. Due to the low activity and low energy of the radiation used in these implants, the patient can be nursed for the duration of their stay in an ordinary single room where they are monitored for potentially expelled sources.

#### **Unsealed radioactive sources**

- 5.35 The source is usually administered to the patient in the form of a liquid (taken as a drink), capsule or by intravenous injection.
- 5.36 Where the source is injected, aseptic and sterile conditions are required. Some therapeutic radiopharmaceuticals arrive from the manufacturer ready to use, while others must be prepared in the hospital radiopharmacy (due to limited stability after preparation). Where radiopharmaceuticals are prepared on-site, they should be delivered on a shielded trolley.
- 5.37 The patient will be accommodated in a specialist shielded single room associated with the in-patient accommodation, and will remain there until the radiation level drops below a defined threshold.
- 5.38 See also paragraph 10.116, 'HDR brachytherapy suite (optional)' and paragraph 11.7, 'Specialist in-patient accommodation'.

## 6 Surgical oncology

- 6.1 Most curative patients will have some form of surgery at some point in their treatment. Surgical oncology is undertaken in standard operating theatres, which will usually form part of the main operating theatre suite. Guidance on the design of surgical facilities for in-patients is provided in Health Building Note 26 Volume 1 – ‘Facilities for surgical procedures’. (Health Building Note 10-02 provides guidance on facilities for day case surgery.)

## 7 Emergency care

- 7.1 Non-surgical oncology patients do sometimes suffer acute complications from their cancer and its treatment, and may require emergency care. Local cancer networks should have clear policies and pathways on the management of complications. All hospitals which might receive these patients should develop an “acute oncology” service to respond effectively, or otherwise have “treat and transfer” arrangements in place.
- 7.2 If a dedicated urgent assessment facility is provided, it is usually part of the oncology in-patient accommodation. Where this facility is not available, patients will be seen in the main Accident and Emergency department. If a patient becomes unwell on the oncology unit itself, clinical spaces within the on-treatment suites in the chemotherapy/radiotherapy units will be used for their assessment. These patients may subsequently be admitted to the main ward via a discreet route.
- 7.3 See also ‘Chemotherapy services in England: Ensuring quality and safety’ (DH, 2009); ‘Manual for Cancer Services: acute oncology – including metastatic spinal cord compression measures’ (DH, 2011).

## 8 In-patient care

- 8.1 Patients may be admitted electively for chemotherapy or brachytherapy treatment. Some patients who become acutely ill may also require admission.
- 8.2 Ward accommodation for cancer patients does not differ from ward accommodation for other patient groups. Depending on the scale of the facilities, designated oncology beds may be provided within the main surgical and medical wards, or there may be dedicated oncology wards, including wards/beds for haemato-oncology.
- 8.3 Dedicated beds for palliative care may also be provided, located in a quiet area of the ward.
- 8.4 See also [Chapter 11, 'In-patient facilities'](#); King's Fund, 'Improving environments for care at end of life'.

### Critical care facilities

- 8.5 Critical care areas (CCAs) for cancer patients do not differ from CCAs for other patient groups. Guidance on critical care facilities is provided in Health Building Note 04-02 – 'Facilities for critical care'.

## 9 Chemotherapy unit

- 9.1 This section describes a chemotherapy unit for the delivery of intravenous and intrathecal chemotherapy, including the management of patients.
- 9.2 It includes specific planning and design considerations and space information for an on-treatment suite and a chemotherapy treatment suite.

### Planning and design considerations

- 9.3 See **Chapter 1, 'Policy context'** regarding quality of environment.
- 9.4 The equipping of generic clinical rooms may depend on the patient groups attending on a local basis; for example, tumour site-specific teams may have particular requirements.
- 9.5 It is assumed that a pneumatic tube system will be used for the transportation of blood samples, if these are being taken by staff on the unit.

### Children's facilities

- 9.6 The provision of dedicated chemotherapy facilities for children and young people is recommended. However, where there is some shared use of facilities, the patient pathways should be kept separate as far as possible and, depending on local need, some clinic spaces should be designated for paediatric use, and decorated appropriately. (Paediatric patients should be treated in age-appropriate treatment facilities as per the NICE guidance.)
- 9.7 See 'Improving outcomes in children and young people with cancer' (NICE); 'Improving outcomes in children and young people with cancer' (DH).

### Clinical trials

- 9.8 The following accommodation is assumed to be provided elsewhere as part of a trust-wide clinical trials service and is outwith the scope of this guidance:

- 1 consulting/examination room(s);
- 2 interview and counselling room(s);
- 3 dedicated in-patient accommodation, where drugs trials involve overnight stays.

## Functional relationships

### Internal functional relationships

- 9.9 **Figure 1** outlines the relationship between the various functions within a chemotherapy unit.

### Relationships with other departments

- 9.10 The chemotherapy unit should be located with good access to imaging facilities, and to a pharmacy dispensary and multi-disciplinary team facilities if these are not provided on the unit.

### *Pharmacy aseptic preparation*

- 9.11 Injectable cytotoxic drugs for use in chemotherapy must be prepared in a dedicated pharmacy aseptic unit – this may be located within a central pharmacy facility or as a pharmacy outpost/"satellite" adjacent to the chemotherapy unit. This guidance assumes the former, and therefore the schedule of accommodation does not provide an allowance for these facilities.

### *Drugs storage and disposal facilities*

- 9.12 Cytotoxic drugs are hazardous, and should be stored in locked and alarmed facilities. The discharge of cytotoxic materials into the environment is regulated. Accordingly, specific routes for disposal must be agreed and described in local rules and protocols. The means of delivery must be safe, secure and traceable. It is not appropriate to deliver cytotoxic drugs by pneumatic tube owing to the risks involved.
- 9.13 See Health Building Note 14-01 for further guidance on the design of an aseptic unit.

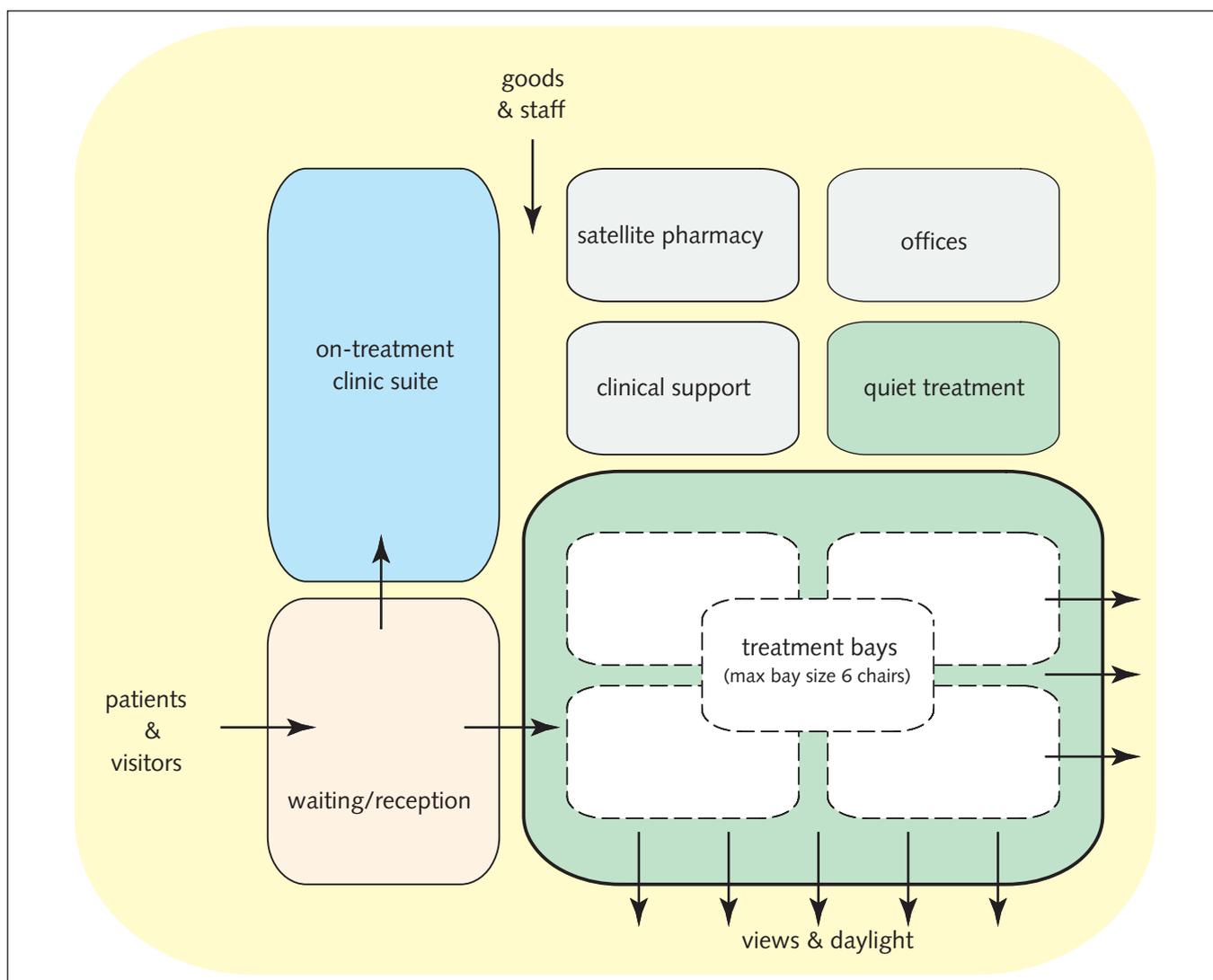


Figure 1 Chemotherapy unit: internal functional relationships

## On-treatment suite

### Function of the suite

9.14 The on-treatment suite may provide for the following functions:

- pre-treatment consultations;
- delivery of oral chemotherapy;
- phlebotomy; and
- the education, assessment and management of patients during the course of their chemotherapy treatment.

9.15 It comprises the following core clinical accommodation:

- examination/therapy rooms, for general nursing procedures;

- consulting/examination rooms;
- interview and counselling.

### Note

If the unit is providing intrathecal treatments (not all providers do), one room must be designated for this purpose. This guidance assumes that one of the exam/therapy rooms in the on-treatment suite will be designated. Some trusts may opt to provide this room elsewhere.

9.16 This guidance assumes that phlebotomy takes place in these clinical rooms rather than in separate designated rooms.

9.17 This guidance also assumes that wig/prostheses fitting, complementary therapies, information

services and other patient support functions will be delivered from generic rooms in the general out-patients department. If the out-patients department is not close by, these services should be delivered from generic rooms in this suite.

### Specific space considerations

- 9.18 If project teams opt to provide a waiting area that serves the entire unit, a separate waiting area would not be required within the on-treatment suite.
- 9.19 The interview room should be located to allow discrete egress without passing through the public areas.
- 9.20 Separate storage is required for intrathecal drugs, as directed by the updated national guidance on the safe administration of intrathecal chemotherapy.
- 9.21 See HSC 2008/001 ‘Updated national guidance on the safe administration of intrathecal chemotherapy’.

### Chemotherapy treatment suite

- 9.22 The overall size of the treatment suite will depend on patient throughput. A mixture of open-plan and individual treatment spaces is recommended.
- 9.23 Patients requiring central venous catheters (CVCs) may need to visit the central diagnostic imaging facility. Some patients will have CVCs inserted in the individual treatment areas in the chemotherapy suite.
- 9.24 Cytotoxic drugs have a deleterious effect on the patient’s immune system, and great emphasis should be placed on designs and finishes that enable staff to keep the treatment unit clean and as free from infection as is reasonably possible while providing a comfortable environment. The design of treatment areas should facilitate easy cleaning and decontamination.

### Chemotherapy treatment area

- 9.25 Open-plan areas should be divided into smaller zones of no more than six chairs. This flexibility in design will enable teams to manage the area according to patients’ preferences at any given time, including to create gender separation if required.
- 9.26 Patients may have adverse reactions to the treatment. Medical oxygen and medical vacuum outlets should be provided, which may be shared between two bays, plus an emergency box with good access to resuscitation facilities.

9.27 Patient entertainment facilities should be provided.



Open-plan chemotherapy treatment area divided into zones (courtesy University Hospital of North Staffordshire NHS Trust)



Patients undergoing chemotherapy (courtesy University Hospital of North Staffordshire NHS Trust)

### Chemotherapy treatment: Single room

- 9.28 There should also be a “quiet” zone of single rooms with en-suite sanitary facilities; these could be used for patients who require clinical seclusion, who

wish to receive their treatment in private, or who require the use of scalp cooling devices.

### Chemotherapy preparation room

9.29 Facilities are required for storing and preparing sterile packs, lotions and drugs for immediate use,

and for preparing/storing trolleys. This provision may be provided as a central facility (16 m<sup>2</sup> would serve 24 patients) or as smaller devolved rooms (9 m<sup>2</sup> per six-chair bay). A local decision will be required as to whether to provide a computer workstation within this area.

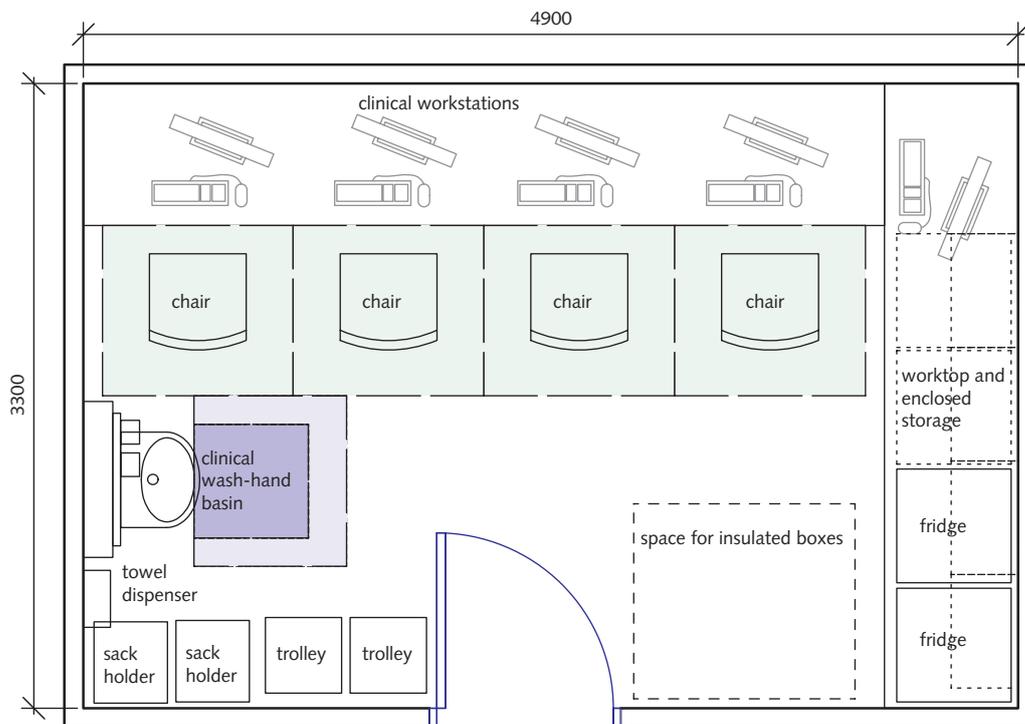


Figure 2 Chemotherapy prep room 16 m<sup>2</sup>: example layout

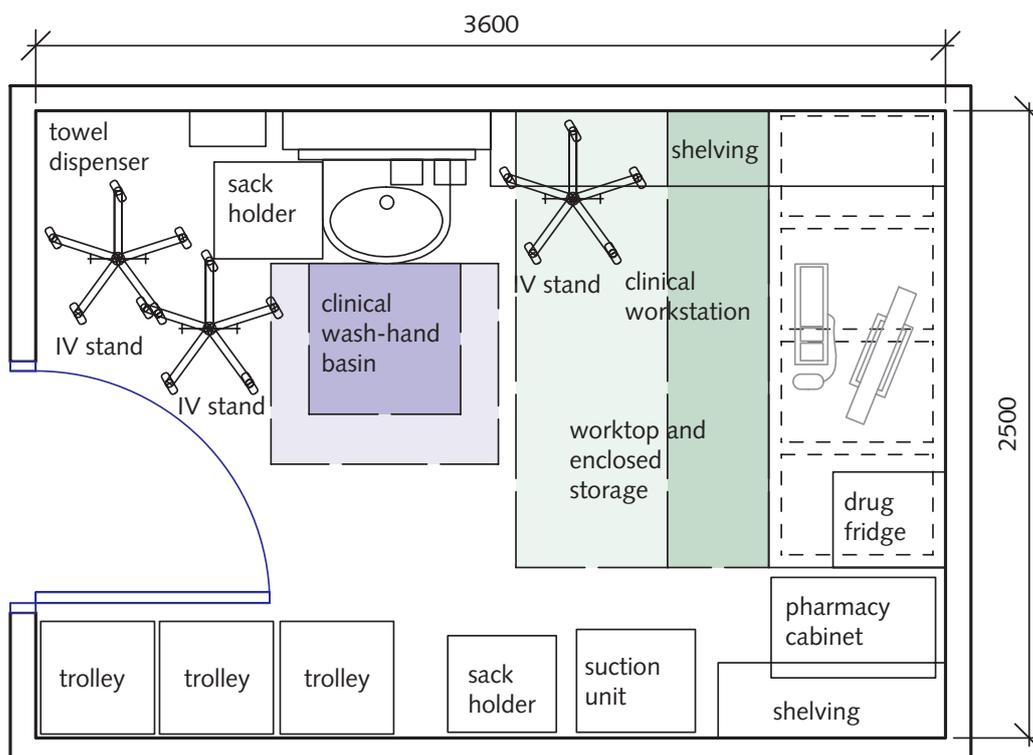


Figure 3 Chemotherapy prep room 9 m<sup>2</sup>: example layout

## 10 Radiotherapy unit

**10.1** This section describes the specific planning and design considerations and space information for a main radiotherapy unit that includes the following accommodation:

- On-treatment review suite
- Radiotherapy treatment suite; superficial/orthovoltage radiotherapy treatment facilities may be provided in this suite
- Imaging suite
- Mould suite
- Radiotherapy physics and technology accommodation

**10.2** An HDR brachytherapy suite may be provided and is also covered in this section.

**10.3** A satellite radiotherapy unit may be provided with close links to the main unit, with two radiotherapy treatment rooms being the usual minimum viable provision. The actual requirements for a satellite unit will be determined by local policy. The schedule of accommodation includes an example for a satellite unit (two bunkers).

### Planning and design considerations

#### Future flexibility

**10.4** The planning and design of radiotherapy facilities should be flexible enough not only to respond to changes in the clinical service, but also to enable equipment servicing and replacement and to accommodate new emerging technologies. The design should ensure that access is sufficient to allow new equipment to be installed with minimal disruption to clinical services. Good external access is required for delivery of equipment by large vehicles.

**10.5** Since the treatment room will outlast the linear accelerator, it is prudent to design the shielding to allow for the highest-energy machine and widest beam that are likely to be installed in the future. It is therefore recommended that all treatment rooms

be designed to house at least 15 MV machines. The design should also allow for neutron protection to be added, if and when required.

**10.6** Where a treatment room is being upgraded to take a higher-energy machine, walls can sometimes be upgraded. Care should be taken to prevent the generation of secondary radiation.

#### UK legislation

**10.7** There are three major items of UK legislation that affect the design and operation of radiotherapy facilities:

- 1 the Radioactive Substances Act 1993;
- 2 the Ionising Radiations Regulations 1999 and the Health and Safety Commission's (HSC) approved code of practice 'Working with ionising radiation'; and
- 3 the Ionising Radiation (Medical Exposure) Regulations 2000.

#### Use of radiation

**10.8** When planning and designing radiotherapy services, project teams must seek radiation protection advice early on from the local radiation protection advisor (RPA) and external advisors. A prior risk assessment is mandatory at the building design stage.

**10.9** Every radiotherapy facility should employ one or more radiation protection supervisors (RPS). The RPS will be a good source of information on local practices and safety rules.

**10.10** Under the Ionising Radiation (Medical Exposure) Regulations 2000, a medical physics expert (MPE) needs to be involved in all procedures involving radiotherapy. The MPE and RPA may be the same person, or they may be different. Both should be consulted when designing new facilities.

**10.11** Early consultation with manufacturers of radiotherapy equipment is also necessary.

## Security of radioactive materials

- 10.12 The planning and design team should also consult the local Counter Terrorism Security Adviser (CTSA) at the earliest opportunity for specialist advice in relation to the secure storage and use of radioactive materials.

## Radioactive discharge

- 10.13 Wherever practical and permitted by law, radioactive materials will be dealt with by leaving them to decay until they have reached a safe or non-radioactive state. This requires the construction of storage facilities known as “decay stores”. For longer-lived materials, some discharge into the drainage system of the hospital or into the air as a result of disposal by burning, in approved incinerators, will be necessary. Discharge to drains or into the air may also occur routinely in the use of radioactive materials or as a result of accidents.
- 10.14 The design of buildings within which radioactive materials are used must constrain their release into the outside environment to levels at or below predetermined levels agreed with the Environment Agency (EA). The EA has the responsibility for licensing such disposals under the Radioactive Substances Act 1993.

## Environmental impact

- 10.15 The International Commission for Radiation Protection (ICRP) states that radioactive materials should only be used where there is no viable alternative. However, where their use cannot be avoided, the level of radioactive contamination of the environment, particularly watercourses into which radioactive fluids are discharged, must be monitored.
- 10.16 Dilution factors are critically important; if a discharge can be rapidly diluted by enabling a drain to join with others of larger flow and capacity, this will minimise radioactive concentrations and the associated hazards.
- 10.17 The RPA will give advice on the environmental impact and will be responsible for generating environmental impact models as needed.
- 10.18 When undertaking building design, the environmental impact of radioactive discharges should be considered at an early stage. Patients who have received unsealed radioactive materials will discharge these in the form of urine and other body fluids. Accordingly, the radioactive materials

administered will be discharged over a short period of time, a few hours, into the drainage system.

- 10.19 Local limits for discharge will exist, and these should be carefully observed.

## Decommissioning of facilities

- 10.20 Unsealed radioactive sources may give rise to chronic contamination of the rooms within which the sources are used, particularly the drainage system from those rooms (if discharge to drains is permitted). In this case, the RPA should be consulted and records examined to determine the nature of the radioactive materials present.
- 10.21 If the half-life is short, it may be wise to delay dismantling pipework etc for an appropriate period of time so that radioactive decay can effectively remove the hazard. Where the half-life is long or such delay cannot be accommodated, special precautions will be necessary and the pipework itself may constitute solid radioactive waste. Should this be the case, the RPA will write a decommissioning scheme of work and will also undertake to work with the EA to ensure appropriate ultimate disposal of the materials.
- 10.22 In respect of the decommissioning of contaminated sinks, drains etc there is a need for care if chemical agents, including bleach, are used to reduce the radioactive burden, since these may oxidise some radioactive materials in solution, rendering them insoluble. This may result in radioactive gases being released into the immediate environment – increasing the hazard to workers. Detailed professional advice must be obtained for each specific situation.
- 10.23 Most linear accelerators do not generate radioactive induction in the built environment or structures around them. Accordingly, for the majority of such installations, there are no special decommissioning criteria, and no special precautions need be taken in respect of radioactivity.
- 10.24 Linear accelerators operating at above 8.5 MV are capable of inducing radioactive activation in their own structures, most notably the collimators or jaws as well as parts of the couch. In very unusual instances, this activation may extend to the bunker shielding that surrounds the machine. Good design can virtually eliminate this problem.
- 10.25 When high-energy linear accelerator treatment rooms are being decommissioned, a radioactivity

site survey should be conducted and the RPA should be consulted as to whether or not special precautions are needed. It is unlikely that the move toward materials such as Ledite will materially affect radioactive activation, though the potential reuse of Ledite is a factor (see “Decommissioning costs” below).

### Decommissioning costs

- 10.26 The decontamination and radiation control issues mentioned above are unlikely to add severely to decommissioning costs in radiotherapy facilities. However, the issue of disposing of large amounts of shielding does have a potential impact.
- 10.27 Reinforced concrete structures can only be removed following on-site breakage and demolition. Waste materials are then removed using heavy vehicles and disposed of by landfill or recycling, which involves crushing the material. Some shielding materials, for example Ledite, can be re-used by simply dismantling and returning to the supplier or redeploying in new buildings. Demolition costs should be considered as part of the business case for any new facility.

### IT infrastructure

- 10.28 A robust IT infrastructure is essential to provide high-speed links capable of transferring large data files between the different pieces of equipment in the radiotherapy department. Access to secure data storage facilities is also essential.

### Children's radiotherapy facilities

- 10.29 Only specialist designated centres will provide services for children.
- 10.30 Although throughput may not justify the provision of dedicated radiotherapy facilities, radiotherapy treatment rooms designated for paediatric use should be decorated to appeal to children.
- 10.31 If there is no local provision for the review of children, dedicated accommodation will be required within the radiotherapy unit.
- 10.32 A separate recovery room should be provided, in close proximity to the treatment room, for children treated under general anaesthetic or sedation.
- 10.33 “Play therapy” can reduce the need for sedation. This involves using toys and games, safely and in a friendly fashion, to reflect treatments the child

may encounter. This should take place in a play therapy room, close to the treatment area.

- 10.34 In dedicated units, consideration should be given to the use of permanently-installed monitoring. CCTV observation is essential. Colour equipment must be used. Voice communication with the patient, accessible to parents/nurses etc, is very useful in reducing fear and gaining patient co-operation.
- 10.35 Children require access to HDR brachytherapy facilities so infrequently that the adult facility will always be used.
- 10.36 Unsealed source treatments present a particular challenge, given the need for a child-friendly yet specialised side ward environment which cannot be used for other purposes for much of the time due to radioactive contamination. The use of adult facilities is feasible but difficult in both nursing and social terms. The giving of such treatments on the open ward is unlikely to be lawful under the Ionising Radiations Regulations 1999. When the mandatory prior risk assessment is undertaken at the building design stage in conjunction with the RPA, the specific intended treatments must be taken into account to determine whether such treatments are appropriate for an open ward environment or whether a side-room is required.
- 10.37 See [paragraph 10.8, ‘Use of radiation’](#); ‘Improving outcomes in children and young people with cancer’ (NICE guidance); ‘Improving outcomes in children and young people with cancer’ (DH guidance).

### Storage

- 10.38 Storage is required for the wide range of materials and tools used (for example plaster models, bandages and acetate), dependent on local requirements. Storage facilities should either be out of sight of patients or have doors. Items such as head and neck moulds that may be distressing for patients should not be stored on open shelves.
- 10.39 Body stereotactic radiotherapy generates a considerable demand for storage of body shells, which will require labelling and cataloguing. Early consultation with the project team will be essential to assess storage needs if stereotactic radiotherapy is proposed. The body shell will need to be kept for as long as the patient is receiving treatment and may, during this period, need replacing to allow for changes in the patient's body shape.

## Functional relationships

### Internal functional relationships

- 10.40 Figure 4 outlines the relationship between the various functions within a radiotherapy unit and reflects the care pathway set out above.
- 10.41 Interview and counselling room(s) should be located near to the entrance/exit of simulator and treatment rooms.

### Relationships with other departments

- 10.42 A radiotherapy physics service is integral to the delivery of radiotherapy treatment. This Health Building Note describes the specific facilities required within the radiotherapy unit itself. However, good access is also required to the general medical physics/clinical engineering services housed elsewhere, within the medical physics department:

*Medical physics (other than radiotherapy physics, including clinical engineering)*

- 10.43 Radiotherapy facilities require good access to mechanical and electronics workshops for equipment maintenance undertaken in-house. Bespoke engineering devices may be required (for example plastic immobilising shells and supporting devices – which should be related to and incorporated in the mould room facilities).

### *Radiopharmacy unit*

- 10.44 Some medical physics departments include a radiopharmacy unit. For guidance on the design of a radiopharmacy unit see Health Building Note (HBN) 14-01 – ‘Medicines management: Pharmacy and radiopharmacy facilities’.
- 10.45 See [paragraph 10.178](#), ‘Radiotherapy physics and technology accommodation’.

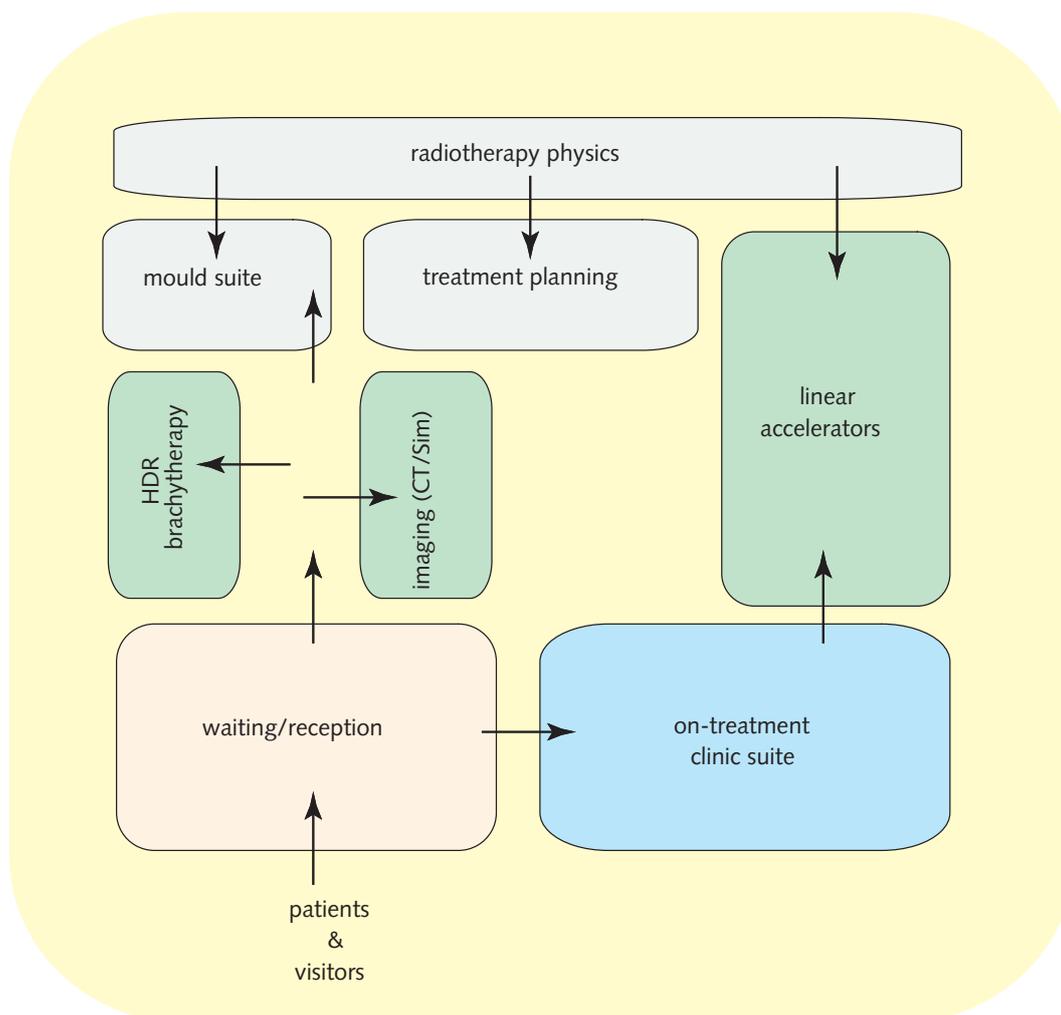


Figure 4 Radiotherapy unit: internal functional relationships

## Public spaces

### Reception/waiting area

**10.46** The waiting area may need to accommodate in-patients arriving for treatment on beds and in wheelchairs with or without drip stands/oxygen cylinders attached, although experience in many recently built schemes indicates that this should be a project option as operational procedures may render it unnecessary.

**10.47** See also 'Entrance, reception and waiting' in Health Building Note 00-03 – 'Clinical and clinical support spaces'.

### On-treatment review suite

**10.48** The on-treatment review suite comprises multi-purpose clinical rooms for the review and management of patients undergoing radiotherapy treatment, for example dietetic activities and discussions. The suite may also be used for the assessment of emergency patients.

**10.49** Since patients may be attending on hospital trolleys, a trolley bay/waiting area should be provided.

**10.50** An anaesthetic room is required if children are being treated on the unit.

### Radiotherapy treatment suite

**10.51** Teletherapy (external beam radiation treatment) is delivered by large machines (usually linear accelerators) situated within shielded facilities, the requirements for which are described in this section. Superficial/orthovoltage facilities may be provided as part of this suite and are also described here.

**10.52** For guidance on the design of facilities for brachytherapy (internally delivered radiation treatment), see [paragraph 10.117, 'HDR brachytherapy suite \(optional\)'](#).

### Radiotherapy treatment rooms (linear accelerators)

**10.53** Linear accelerators must be installed in purpose-designed treatment rooms (known as bunkers) with very heavy protective radiation shielding built into the construction.

**10.54** These rooms should be large enough to allow easy access and movement of a patient on a bed, hoist, trolley or wheelchair. The design must also allow full clinical use and setup of all machines,

including complete 360° rotation of gantries and tables. The entrance to the room should be wide enough to allow access for linear accelerators, large heavy components and subsequent replacement machines. Corner/wall protection against damage by equipment, wheelchairs, stretchers, beds etc should be provided, as should crash rails.

**10.55** The entrance will usually comprise a shielded corridor or maze to prevent the escape of X-rays into the adjacent environment. Some designs feature heavy protective doors without the provision of a maze (usually because of space restrictions). Another option is to install a short maze with a half door (which will open more quickly than a full door).

**10.56** The width of the primary barrier, the design of the entrance to the room, and the level of shielding above and below the linear accelerator, all depend on the design of the machine to be used, and the usage of adjacent rooms.

**10.57** Access control gates and/or infrared beams/photoelectric cells must be provided to cut off/interlock to the machine.

**10.58** Privacy and dignity issues should be considered, including siting of doors and/or entries into treatment rooms.

**10.59** Environmental services usually gain access to the treatment room via the ceiling void of the maze. The effectiveness of shielding in the maze is often increased by concrete baffles. These should overlap to stop the direct path of radiation, but should be offset from each other and positioned in such a way as to allow services to weave through them.

**10.60** The ceiling should be sufficiently strong, and there should be sufficient space above the false ceiling to allow for electrics for back-lit images and other technologies.

**10.61** Trenches and floor chases for hidden cables and support frames will be extensive and will vary from one manufacturer to another. It may be possible to establish, through consultation with manufacturers, the extent and critical dimensions of these features. This information should be available to the design team at an early stage in the design process to allow the features to be incorporated into relevant drawings and to ensure that the integrity of fire compartmentation is not breached.

- 10.61 A floor trench between the wall of the treatment room and the control area is required to gather all services passing between the control area and the linear accelerator.
- 10.63 A duct will pass between the floor trench and a similar trench in the control area. The trench and ducts should not compromise the radiation shielding offered by the shielding walls or floor (in the case of a treatment room with radiation-sensitive areas beneath).
- 10.64 Radiotherapy treatments must be precise and accurate in terms of aiming the beam at the intended target. This requirement means that almost all linear accelerators use a base frame set into the floor that links the accelerator gantry to the patient support device or couch.
- 10.65 A recess is needed for the base frame and table floor; this will need to allow service connection back to the treatment machine base and floor trench.
- 10.66 A lifting beam could be located over the centre of the linear accelerator, or an A-frame crane could be used instead.
- 10.67 Supports are required for heavy ceiling-mounted equipment such as the frames of data monitors.

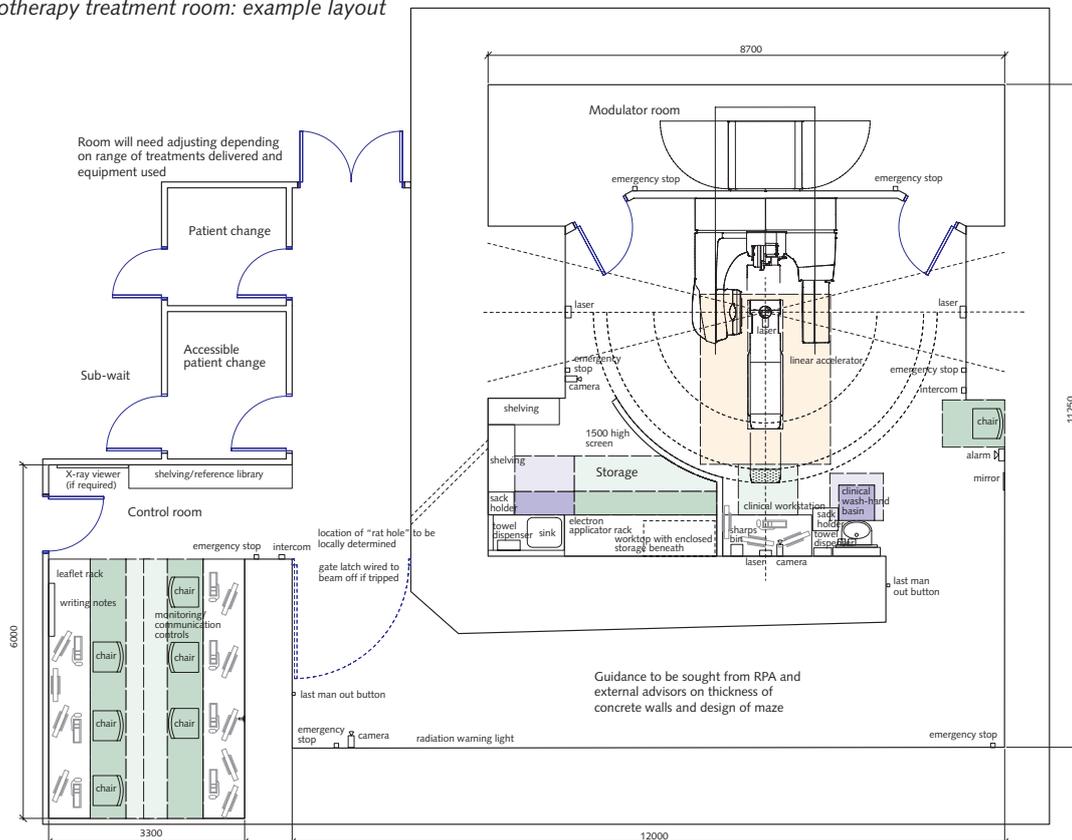


Linac machine (courtesy Derby Hospitals NHS Foundation Trust)



Clinician operating linac machine (courtesy Derby Hospitals NHS Foundation Trust)

Figure 5 Radiotherapy treatment room: example layout



Rigid support is needed for wall-mounted alignment lasers and ceiling lasers.

### *Storage facilities*

**10.68** Storage will be required for a wide range of medical equipment, the requirements to be determined in consultation with users and machine specialists. RPA advice is essential on the suitability of storage facilities; for example, metallic shelves may not be appropriate in some circumstances.

**10.69** Bespoke storage facilities, repeated in each treatment room, will allow staff to move between rooms and work more efficiently, as they will be familiar with storage arrangements in each room.

**10.70** Specialised storage is needed for immobilisation devices, vacuum bags and body casts.

**10.71** Accessory equipment (for example breast boards, lung boards, electron applicators and their lead end pieces) should have dedicated storage, either in cupboards, on shelves or hanging.

**10.72** Storage should be provided for total body irradiation (TBI) and stereotactic body radiation therapy (SBRT) equipment.

### *Other design features*

**10.73** The following facilities should also be provided in treatment rooms:

1. wall-mounted dispensers for paper towels, paper cups, soap, paper sheets etc;
2. wash-hand basin, shelf and mirror;
3. chair for patient;
4. coat hooks;
5. alignment lasers firmly bolted to structure, linked to laser generator using fibre-optic cable;
6. last-man-out button, located near entrance to maze (advice to be sought from the RPA and HSE);
7. safety sign and warning light at entrance to treatment room and within the room;
8. emergency stops for the linac;
9. music facilities;
10. CCTV cameras mounted at high level to monitor patient during unaccompanied periods;

11. two-way communication system between control area and treatment room;

12. access to IT, workstations and wireless connectivity.

**10.74** The number of CCTVs required will depend on local practice. Closed-circuit televisions should have pan and zoom facilities and secrecy switches. They may be interlocked to the entry system to the maze, provided the interlock can be overridden from the control area.

### *Interior design of treatment rooms*

**10.75** The dominating nature of a linear accelerator and the mass of high-tech equipment presents a daunting experience for patients. Every opportunity should be taken with the interior design to create a pleasant, non-intimidating environment with a sense of order and reassurance. Lighting will play an important role.

**10.76** Murals and paintings on walls and ceilings may provide welcome distraction. Consultation on artwork should begin at an early point in the design process. Care should be taken when positioning artwork to avoid obstructing patient support aids and the sightline of lasers. Artwork must not cover radiation warning lights or emergency stops.

### *Environmental and engineering considerations*

**10.77** Lighting will need to vary from subtle and non-glaring (for patient relaxation) to high-level (for maintenance tasks). It should be possible to dim the lighting. A spotlight is required at the foot of the couch/bed. Ventilation (number of air changes) must be adequate to remove ozone formed during treatment as well as for staff/patient comfort. Local variable temperature control is required. Access to chilled water is required for the operation of the linacs.

**10.78** Particular consideration should be given to fire protection systems in linear accelerator treatment rooms, where patient movement may be compromised.

### **Other radiotherapy treatment suite spaces**

#### *Waiting area (optional)*

**10.79** Waiting areas may be provided either as sub-waits associated with a single or a pair of linacs or

centralised within one area, depending upon the size and layout of the unit.

- 10.80** If the trust's operational policy requires supervision/observation of the sub-wait areas, this may be provided from the linear accelerator control room, where the design solution permits.

#### *Trolley waiting area (optional)*

- 10.81** Where necessary, a trolley bay can be provided in an area easily observed by clinical staff and not closed off. Every effort should be made to ensure privacy and dignity; however, patient safety is of paramount importance.

#### *Patient changing*

- 10.82** Patient changing facilities should comprise separate lockable changing rooms adjacent to treatment/imaging rooms and positioned so others cannot see patients while changing or once they have changed.
- 10.83** A minimum of two changing rooms is required. One should be of sufficient size to permit changing for patients with a disability and those on stretchers/beds.
- 10.84** Ideally, patient changing rooms should be "pass through", with the patient entering on one side and exiting on the other into the imaging room. If a separate waiting area is provided for changed patients, gender separation should be ensured.
- 10.85** See also 'Changing facilities' in Health Building Note 00-02 – 'Sanitary spaces'.

#### *Linear accelerator control areas*

- 10.86** The number of computers, printers, keyboards, workstations etc will depend on local practice and choice of manufacturer.
- 10.87** Early consultation is recommended to establish equipment requirements and the equipment's position relative to the maze entrance and patient areas. Efficiency of patient observation, ease of staff movement, data protection and staff training requirements are key considerations.
- 10.88** Staff require easy access to the treatment room maze. They also need to be able to see members of the public approaching the maze entrance, while shielding from view the monitors displaying patient information.
- 10.89** The minimum depth of worktops should be 1000 mm to accommodate large computer

monitors. This is being reviewed in view of the introduction of flat screens.

- 10.90** A minimum of 9000 mm length of worktop space will be required for each linear accelerator. There should be sufficient space between the control desk and wall to allow radiographers to move behind each other.
- 10.91** The requirement for X-ray viewing boxes and darkroom facilities will be determined locally.
- 10.92** Daylight in the control area is highly desirable, but monitors should not be subject to glare from direct sunlight.
- 10.93** A large number of sockets, computer network and telephone points will be required in the control areas. Trunking systems that offer flexibility and change may be appropriate.
- 10.94** Dosimetry and QA monitoring cables should run through "rat holes" and be terminated in suitable places in the control area and in the treatment room. There should be provision for two sets of dosimetry cables to: (a) provide some redundancy; and (b) facilitate cross-calibration of ion chambers against each other. The tunnel should be angled to ensure that it does not provide a direct path for any radiation.

#### *Radiographer preparation room*

- 10.95** There should be separate rooms adjacent to each control area where the following activities take place:
1. data preparation for treatment;
  2. calculations;
  3. image review and manipulation;
  4. data transfer checking;
  5. capturing initial set-up parameters.
- 10.96** If lack of space precludes provision of a separate room, the control area should be large enough to accommodate these functions, but this might prove distracting. Care should be taken to ensure that patients cannot hear clinicians' conversations or view screens with confidential information displayed.

#### *Treatment planning room*

- 10.97** Workstations should be located in quiet areas. Medical staff review portal images, treatment plans and outline volumes.

- 10.98 The workstations should be networked to the treatment planning system, PACs and record and verify system. The system should have access to data from the imaging modalities and brachytherapy equipment.
- 10.99 Electronic communication links are required to the supplier of the treatment planning system for “remote diagnostics testing” as part of service agreements.
- 10.100 Where paper treatment sheets are still used, these will be stored in the medical records department. Some storage may still be required for blank treatment sheets where these are written by hand.
- 10.101 Film storage will depend on local practice.

**Superficial/orthovoltage radiotherapy treatment facilities (optional)**

*Superficial/orthovoltage radiotherapy treatment room*

- 10.102 An orthovoltage machine is more powerful than the superficial machine and gives out levels of energy that require concrete walls to protect the adjacent spaces, whereas a superficial machine only requires X-ray standard protection. Orthovoltage machines can be used at a lower output to deliver superficial treatments.
- 10.103 For full future flexibility, all rooms should ideally be sized and shielded to accommodate an

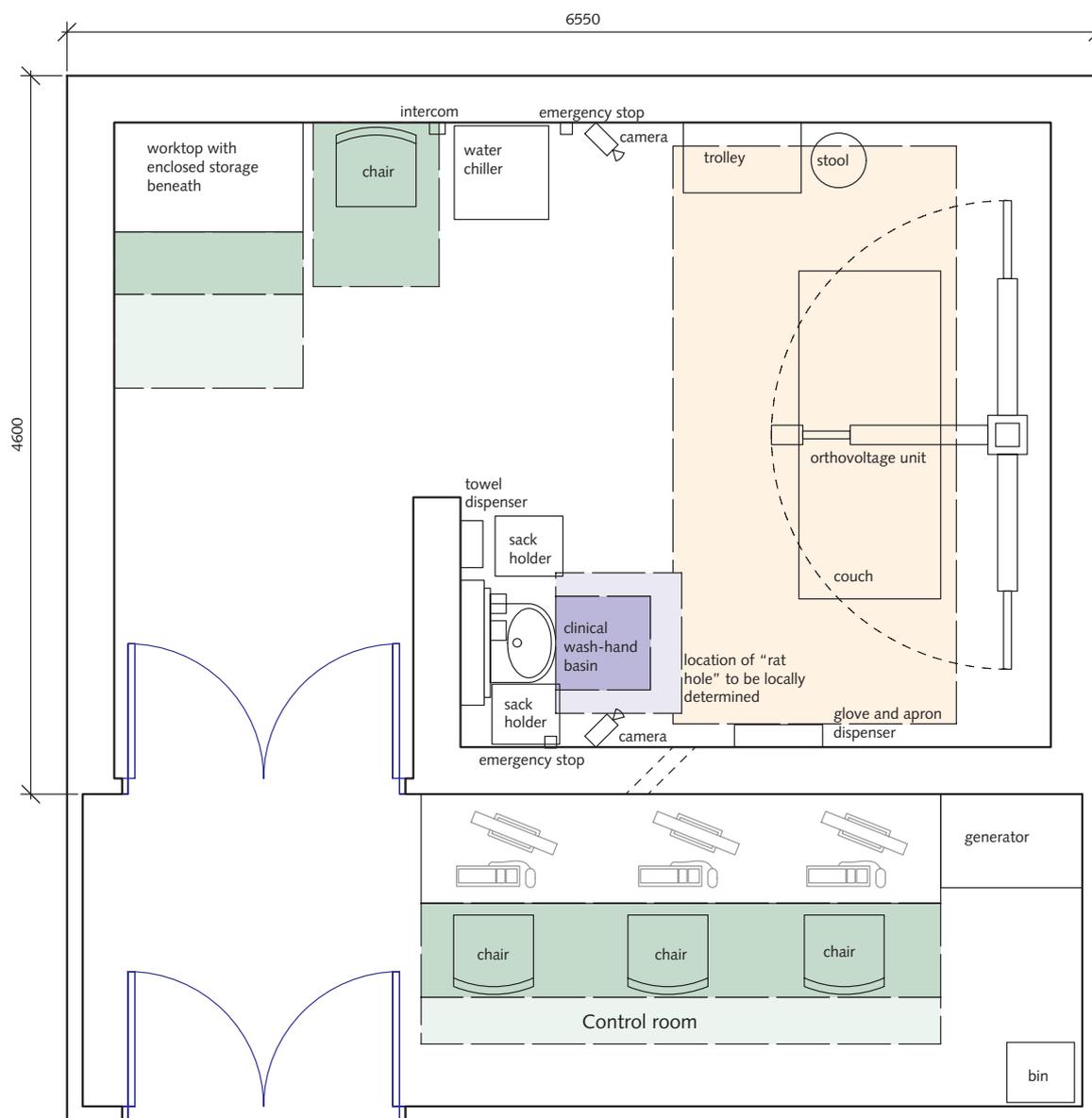


Figure 6 Superficial/orthovoltage radiotherapy treatment room: example layout

Guidance to be sought from RPA and external advisors on thickness of concrete walls and design of maze

orthovoltage machine. A small maze is a viable alternative to heavy door construction.

- 10.104 The X-ray tube should be mounted on a simple but robust floor or ceiling suspension and powered by a conventional X-ray generator system. Doors and viewing windows must be constructed with adequate radiation protection. CCTV may be used in addition, or as an alternative, to a window.
- 10.105 Rooms should be of sufficient size to allow all areas of the patient's body to be treated with the patient lying/sitting in a stable position.
- 10.106 They need to contain specialist shelving to house the beam-defining applicators.
- 10.107 Each room should contain a mobile treatment couch, spotlight, clinical wash-hand basin and patient wash-hand basin.
- 10.108 There should be an interlocked door between the treatment room and the control area.

#### *Machine room: Superficial/orthovoltage*

- 10.109 The requirements for this room are specific to the equipment manufacturer.

#### *Control area: Superficial/orthovoltage*

- 10.110 The number of computers, printers, keyboards, workstations etc will depend on local practice and choice of manufacturer.
- 10.111 Early consultation is recommended to establish equipment requirements and the equipment's position relative to the maze entrance and patient areas. Efficiency of patient observation, ease of staff movement, data protection and staff training requirements are key considerations.
- 10.112 Staff require easy access to the treatment room maze. They also need to be able to see members of the public approaching the maze entrance, while shielding from view the monitors displaying patient information.
- 10.113 The requirement for X-ray viewing boxes will be determined locally.
- 10.114 Daylight in the control area is highly desirable, but monitors should not be subject to glare from direct sunlight.
- 10.115 A large number of sockets, computer network and telephone points will be required in the control areas. Trunking systems that offer flexibility and change may be appropriate.

- 10.116 Dosimetry and QA monitoring cables should run through "rat holes" and be terminated in suitable places in the control area and in the treatment room. There should be provision for two sets of dosimetry cables to: (a) provide some redundancy; and (b) facilitate cross-calibration of ion chambers against each other. The tunnel should be angled to ensure that it does not provide a direct path for any radiation.

### **HDR brachytherapy suite (optional)**

- 10.117 Prior to delivery of brachytherapy, an applicator or tube is inserted or implanted in the patient, often in a treatment room which has been constructed to undertake surgical procedures as well as brachytherapy. Where the implantation is performed in an operating theatre suite separate from the treatment room, the patient is taken on a trolley from theatre to either an MR or CT scanner and thence to the HDR suite.
- 10.118 This guidance assumes that the patient would be changed already from theatre, so patient changing facilities are not required as part of the suite.
- 10.119 A recovery room is required.

### **Functional relationships**

- 10.120 The following diagram outlines the relationship between the various functions forming a HDR brachytherapy suite.

### **HDR brachytherapy treatment room**

- 10.121 HDR treatment must be undertaken in a shielded room incorporating a small maze and/or a protective door. A dedicated treatment room may be located in the radiotherapy unit or may be associated with an operating theatre suite. Alternatively, treatment may be delivered in a linear accelerator treatment room within the radiotherapy unit. This reduces building and maintenance costs but interrupts the use of the linear accelerator.
- 10.122 Ideally, access to the room should be through the control room (see [Figure 7](#)). The security features required by the HASS regulations must be incorporated into the treatment room design. Two physical barriers are required: this can be achieved with a secure inner door and steel roller shutter outer door. A source exposed indicator should be sited on the rear wall of the room where it can be seen as the door opens.

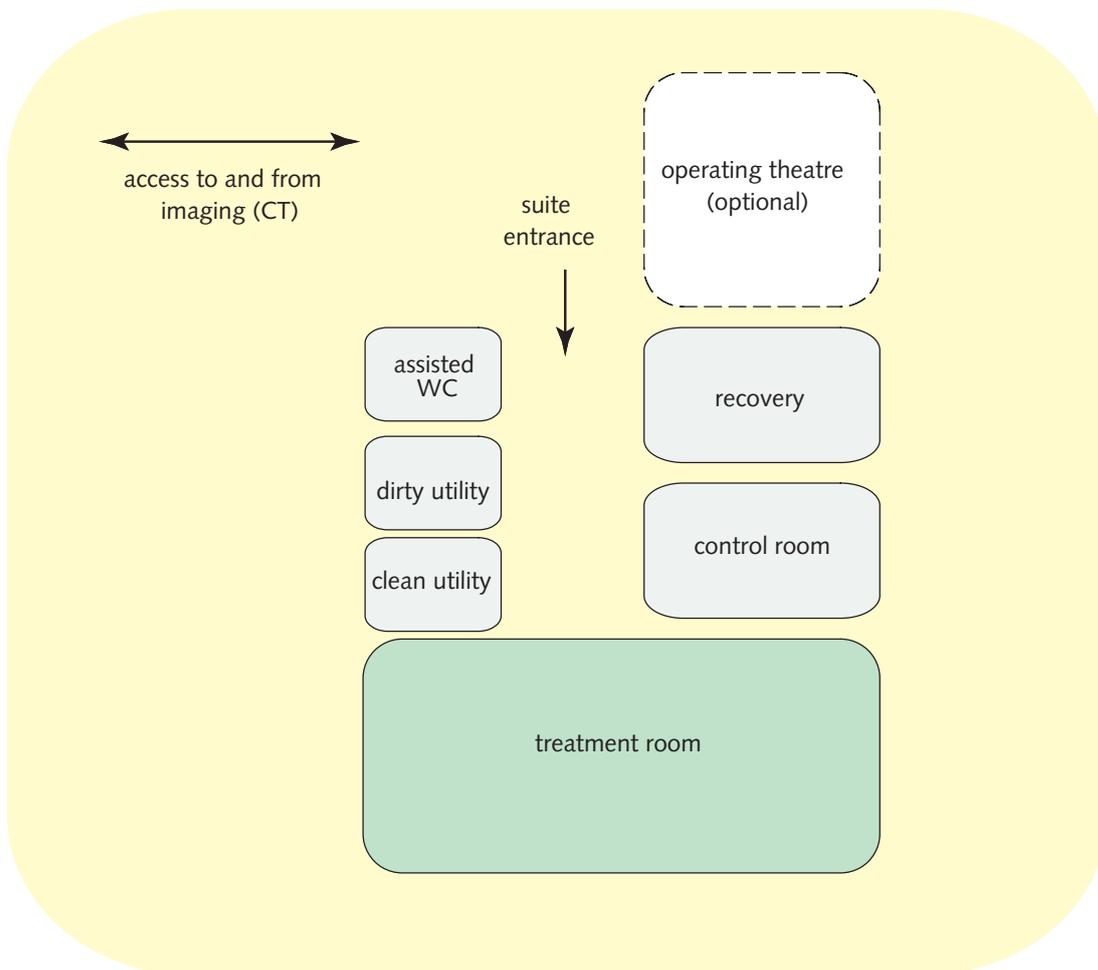


Figure 7 HDR brachytherapy: internal relationships

- 10.123** The size and design of the room should be appropriate for the procedures that are to be performed in the room. Procedures requiring extensive pre-cleaning and post-cleaning should be performed elsewhere, and the room should be used for treatment delivery only. If insertions are undertaken in the brachytherapy treatment room itself, it must be appropriately equipped for surgical procedures. The room should be large enough to allow access for fluoroscopy equipment and crash trolley if required. Space requirements for new procedures and technological developments should be considered.
- 10.124** Open worktop bench space should be provided, the length dependent on local requirements.
- 10.125** Oxygen and suction facilities are required.
- 10.126** A sink is required for the cleaning of equipment, along with a separate wash-hand basin for staff use.

- 10.127** Adequate storage should be provided outside the room for applicators, accessories and QA equipment so the room is easily cleanable and remains uncluttered.
- 10.128** Search (last man out) buttons should be positioned so the whole room can be seen by the operator upon actuating it.



HDR brachytherapy treatment space (courtesy Derby Hospitals Foundation Trust)

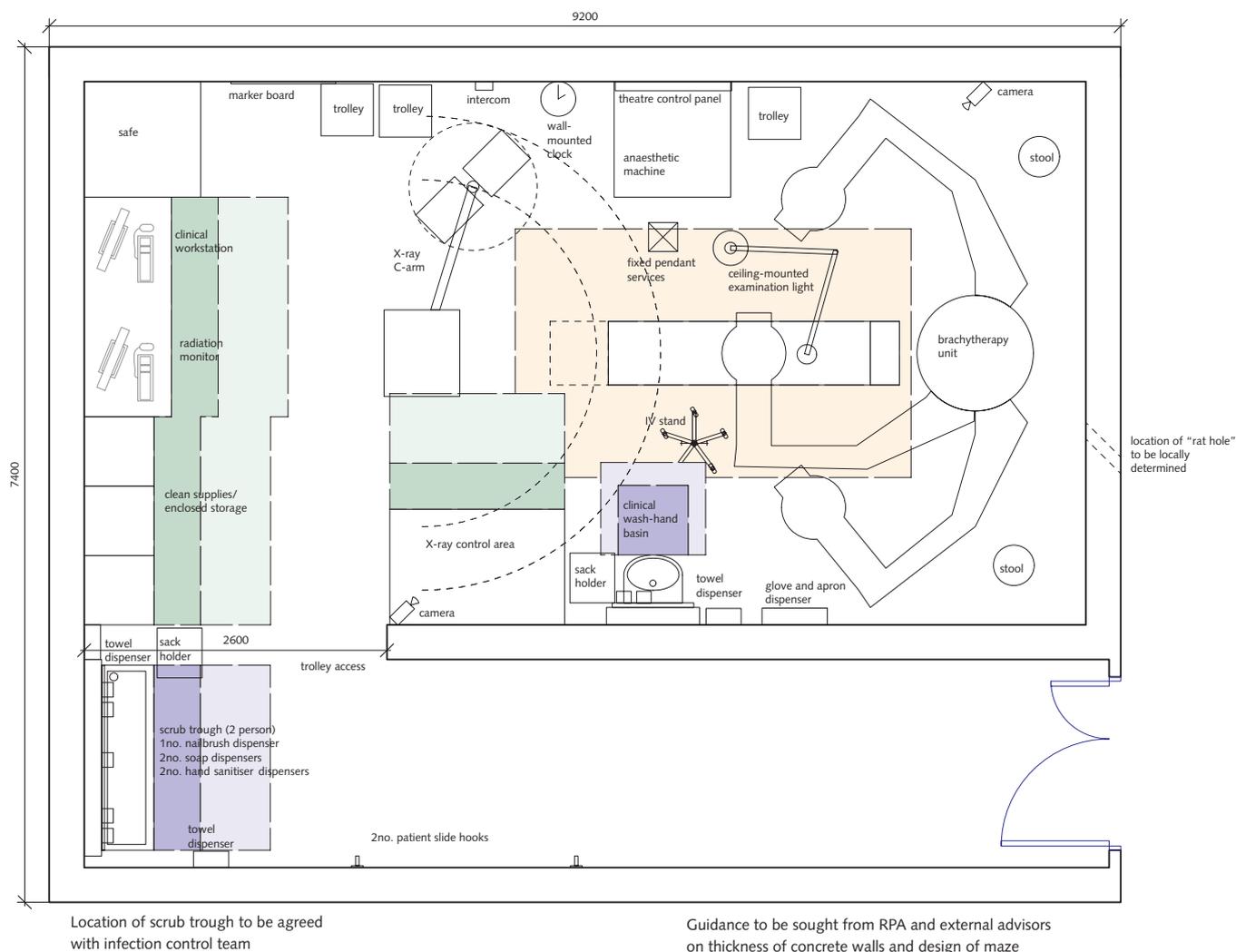


Figure 8 Brachytherapy room: example layout

### Control area: Brachytherapy

- 10.129 A remote protected observation/control area will also be required. This provides safe monitoring of the entrance to the room. CCTV will be needed for patient observation. Intercom facilities between the treatment room and control area are required to permit direct communication with the patient during the treatment. A “rat hole” should be provided between the treatment room and control area, as described for the linear accelerator control room.
- 10.130 The number of computers, printers, keyboards, workstations etc will depend on local practice and choice of manufacturer.
- 10.131 Early consultation is recommended to establish equipment requirements and the equipment’s position relative to the maze entrance and patient areas. Efficiency of patient observation, ease of staff movement, data protection and staff training requirements are key considerations.
- 10.132 Staff require easy access to the treatment room maze. They also need to be able to see patients approaching the maze entrance, while shielding from view the monitors displaying patient information.
- 10.133 The requirement for X-ray viewing boxes will be determined locally.
- 10.134 Daylight in the control area is highly desirable, but monitors should not be subject to glare from direct sunlight.
- 10.135 A data safe should be used to store source and treatment records.
- 10.136 A large number of sockets, computer network and telephone points will be required in the control areas. Trunking systems that offer flexibility and change may be appropriate.

10.137 Dosimetry and QA monitoring cables should run through “rat holes” and be terminated in suitable places in the control area and in the treatment room. There should be provision for two sets of dosimetry cables to: (a) provide some redundancy; and (b) facilitate cross-calibration of ion chambers against each other. The tunnel should be angled to ensure that it does not provide a direct path for any radiation.

**Store: Sealed radioactive source**

10.138 The function of this room is to provide a suitable environment for the receipt, storage and handling of solid or sealed radioactive materials. It should be located alongside the brachytherapy rooms.

10.139 The design must comply with the Health and Safety Executive’s (HSE) approved code of practice ‘Working with ionising radiation’ and the High-activity Sealed Radioactive Sources and Orphan Sources Regulations 2005 (the ‘HASS Regulations’).

10.140 An area will be needed for recording radioactive materials in stock and in transient use. Storage will be required for shielded containers used for transporting radioactive materials and for applicators and accessories in regular use.

10.141 If preparation and handling of radioactive sources takes place in the unit, a shielded work bench may be required, normally constructed using lead. Because of the weight of lead shielding needed, localised floor loading will be abnormal and will need to be taken into account, either by design of the structure or by siting.

10.142 A storage safe is required for the sealed sources. The preparation varies with the treatment requirement, but will always include an assay of the radioactivity present and may involve source sterilization.

**Imaging suite**

**Waiting area**

10.143 If the trust’s operational policy requires supervision/observation of the sub-wait areas, this may be provided from the imaging control room, where the design solution permits. See also ‘Waiting area’ in Health Building Note 00-03.

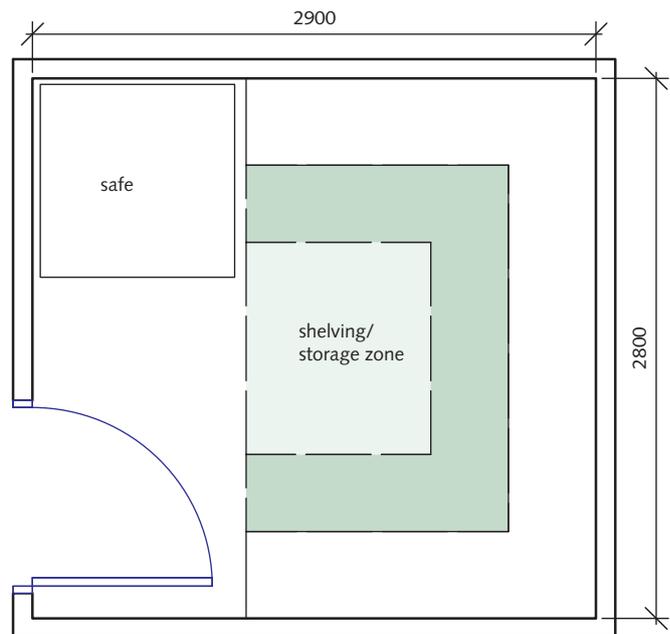


Figure 9 Sealed radioactive source store: example layout

**Patient changing**

10.144 Patient changing facilities should comprise separate lockable changing rooms adjacent to treatment/imaging rooms and positioned so others cannot see patients while changing or once they have changed.

10.145 A minimum of two changing rooms is required. One should be of sufficient size to permit changing for patients with a disability and those on stretchers/beds.

10.146 Ideally, patient changing rooms should be “pass through”, with the patient entering on one side and exiting on the other into the imaging room. If a separate waiting area is provided for changed patients, gender separation should be ensured. See also ‘Changing facilities’ in Health Building Note 00-03.

**Imaging room(s)**

10.147 The design of an individual room is dependent on the type of imaging device to be installed but must include adequate protection measures against hazards.

10.148 Orthogonal lasers are an essential component of any imaging room to facilitate the positioning of patients.

10.149 The orientation of the imaging device within the room will depend on the space and local preference, but easy access is required to the



CT scanner (courtesy Derby Hospitals NHS Foundation Trust)

couch by trolleys, beds, a portable hoist and wheelchairs.

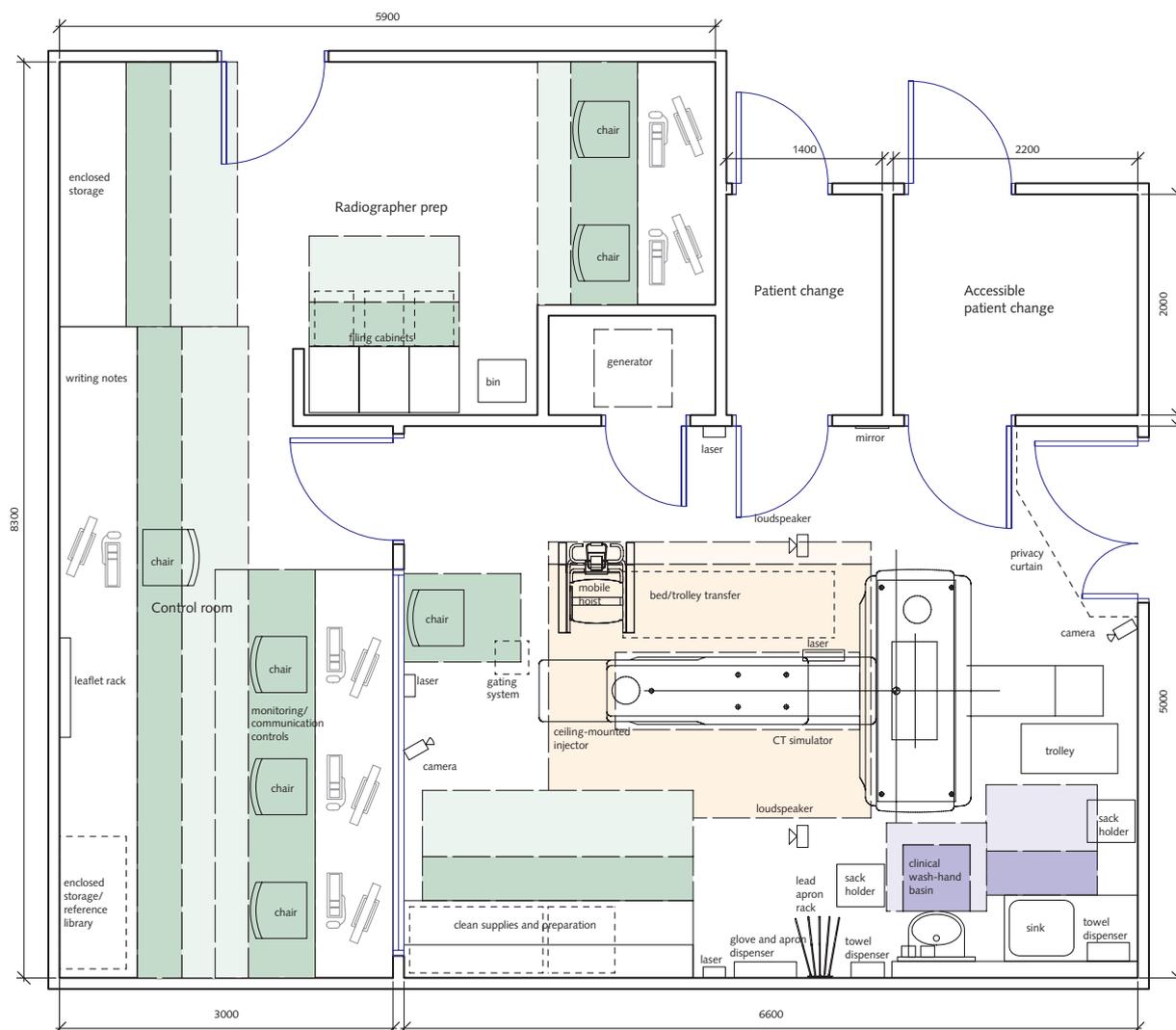
10.150 Facilities must include injection facilities and, depending upon local operational policies, anaesthetic gases.

- 10.151 Dedicated storage is required in cupboards, on shelves or hanging for accessory equipment (for example phantoms, QA devices, immobilisation devices) and a range of couch tops.
- 10.152 The position of the viewing window should provide the best possible view of the patient during the imaging procedure and the equipment as it moves by remote control. CCTV should be provided to enable the patient to be viewed at all times during a procedure.
- 10.153 See Health Building Note 6, 'Facilities for diagnostic imaging and interventional radiology', for the design requirements, including shielding.

**Generator room**

10.154 The requirements for this room are specific to the equipment manufacturer.

Figure 10 Imaging room: example layout



### Imaging control area(s)

- 10.155 There should be a closed control area adjacent to each imaging room with access to the imaging room and patient changing facilities. The area should include an appropriately shielded viewing window. The design of the control area should be appropriate to the imaging modality and local practice.
- 10.156 Adequate workbench space with network points should be allocated for the workstations and imaging device monitors and to permit local clinical practice. This will include consideration of viewing of images and data from PACS systems, electronic patient management systems and manipulation of data acquired during individual imaging sessions.
- 10.157 Other requirements include a telephone, cupboards/drawers/shelving for storage, a lockable cupboard for drugs, and space for storage of contrast media in an appropriate temperature-controlled environment.



Imaging control area (courtesy Derby Hospitals NHS Foundation Trust)

### Radiographer preparation room

- 10.158 There should be separate rooms adjacent to each control area where the following activities take place:
- data preparation for treatment;
  - calculations;
  - image review and manipulation;
  - data transfer checking;
  - capturing initial set-up parameters.
- 10.159 If lack of space precludes provision of a separate room, the control area should be large enough to accommodate these functions. Care should be taken to ensure that patients cannot hear clinicians' conversations or view screens with confidential information displayed.

### Imaging clinical preparation room

- 10.160 A clinical room is required for the preparation of patients requiring barium, catheterisation and other pre-imaging clinical procedures. It should include facilities to store, prepare, dispense and clear away drinks etc.

### Mould suite

#### Impression and fitting room

- 10.161 It will frequently be necessary to immobilise the patient to ensure the safe and accurate delivery of teletherapy. To achieve this, a mask is custom-made from various materials, for example thermoplastics or thin plastic sheets (PETG), to match the patient's features. This is fitted onto the patient and registered to the treatment couch, thus restricting patient movement during treatment.
- 10.162 To align the part of the body to receive radiation treatment, it may be necessary to support a particular limb or other part of the body. This may be achieved using vacuum bags or foam blocks, which are available as standard items or may need to be specially produced, to be decided locally.
- 10.163 A room is required for the manufacture of immobilisation shells or supporting devices, providing wheelchair/bed access. The patient will usually need to remove clothing, therefore changing facilities within an adjoining room area will be needed.

- 10.164 The process may be lengthy and unpleasant, and may involve taking impressions. To ease the process for the patient, the room should offer a light, airy environment and be as comfortable as possible. Ceilings may be designed with some point of interest to relieve patients' boredom. Background music may also be considered. Seating should be provided for relatives or carers accompanying patients. The provision of a WC in the vicinity of the mould suite should also be considered.
- 10.165 A dentist's chair and height-adjustable couch may be required. The dignity of the patient should be considered when locating the couch in relation to doors. Relocatable frames will be required when using stereotactic techniques instead of shells.
- 10.166 A wash-hand basin, mirror, shelf, seat and coat hooks will also be required.
- 10.167 If plasterwork is undertaken, a plaster sink with splash-back will be required in addition to the patient wash-hand basin. For guidance on the design of plaster sinks see 'Sanitary assemblies'.
- 10.168 A hot-water bath, with filling and draining facilities, will be required for use of thermoplastics.
- 10.169 Locally adjustable heating and ventilation should be provided to control local heat gain and odours.
- 10.170 The floor covering should be non-slip linoleum or vinyl with coved skirting for ease of cleaning.
- 10.171 Alignment lasers should be fitted in the mould room at the same height as those in the linear accelerator treatment rooms.
- 10.172 Technicians will need to view imaging data and carry out clerical work and reporting. A workstation should be provided with a computer network point, sockets, telephone and filing cabinet.
- 10.173 See also Health Building Note 00-02 'Sanitary spaces'.

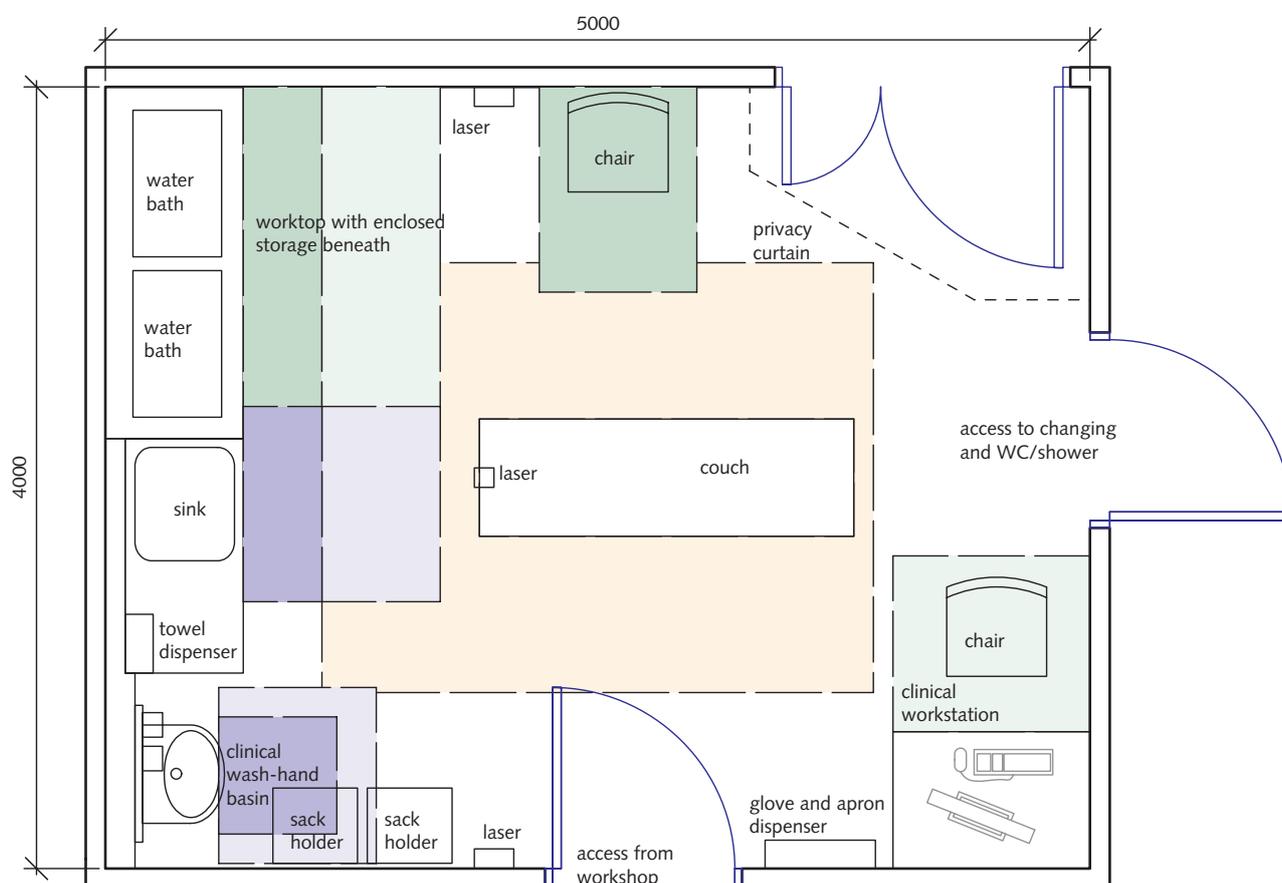


Figure 11 Impression and fitting room: example layout

## Patient changing

10.174 Ideally, patient changing rooms should be “pass through”, with the patient entering on one side and exiting into the mould room. See also ‘Changing facilities’ in Health Building Note 00-03.

## Workshop

10.175 The requirements for the workshop will depend on the range of immobilisation solutions provided by the centre. It should have adequate bench space and be divided into clean and dirty (plaster) areas. Open shelving/storage in the room should be kept to a minimum owing to dust levels in the workshop. A laboratory gas supply should be provided as the heat source for tools required for plastics work.

10.176 Where the range includes custom-made beam directional shells, a vacuum-forming machine, plaster sink and plaster work area will be required. (Vacuum-formers produce significant heat, which should be considered in the planning.) Where plasterwork is performed, local dust extraction should be provided. An equipment sink and wash-hand basin are required. Non-slip flooring should be used throughout.

10.177 A laser should be provided above a clean work area for setting up shells etc (wax bolus, lead masks, wax blocks etc).

## Radiotherapy physics and technology accommodation

10.178 The following radiotherapy physics and technology accommodation should be provided within the radiotherapy unit itself, as a minimum, for undertaking equipment maintenance and repairs and contributing to quality assurance:

- a. electronics workshop/laboratory;
- b. office accommodation: as a minimum desk space for two engineers;
- c. stores, including a bulky equipment store.

10.179 Optional facilities, depending on access to the main medical physics facilities, may include:

- a. mechanical workshop and machine room;
- b. dosimetry laboratory;
- c. offices for radiation protection, research and imaging physicists, depending on the configuration of services in the individual trust.

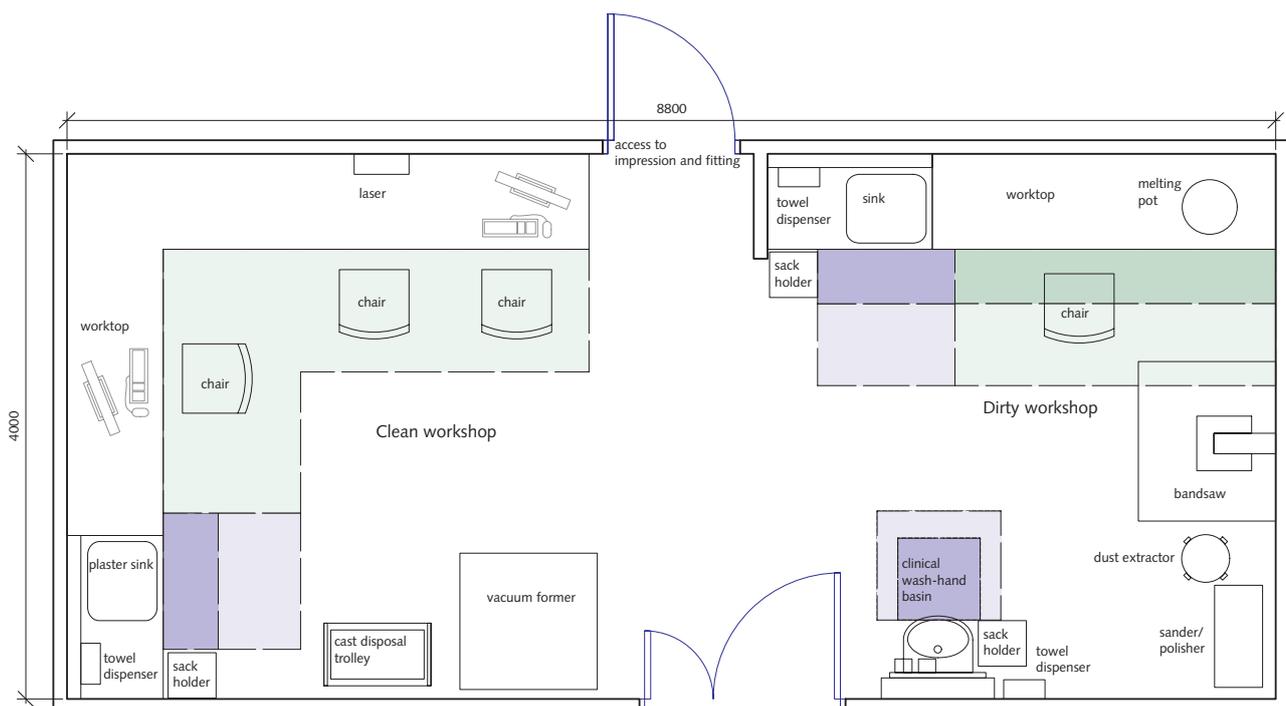


Figure 12 Workshop: example layout

### Electronics workshop/laboratory

10.180 A clean, dust-free environment is important, as is good-quality general lighting, with task lighting at workbenches. Natural lighting and ventilation is preferable, although solar control and mechanical ventilation may be needed to maintain suitable working temperatures.

10.181 Other requirements include:

- a. generous benching with cupboards and drawers underneath;
- b. bench-mounted trunking to provide adequate power outlets;
- c. desk space to perform record-keeping and logs;
- d. shelves and bookcases for manuals and records;
- e. telephone and computer workstation.

### Offices

10.182 Consideration should be given to the tasks undertaken in offices, which will require access to the IT network for treatment plan review and approval, access to high-quality X-ray, CT/MR images through PACS or the radiotherapy archive, and access to the radiotherapy record and verify/scheduling system as well as standard NHS and office software. Standard telecommunications are required. Space is also required for QA equipment and mobile devices.

### Stores

10.183 Storage facilities should be large enough to accommodate large items such as dosimetry plotting tanks and other large QA and calibration equipment items, and A-frame lifting devices. They should also be provided with hooks and racking to store a range of spares, components and cables.

### Mechanical workshop and machine room (optional)

10.184 Equipment will vary depending on local requirements, but is likely to include:

- a. vacuum-forming machine with compressor;
- b. contouring device;
- c. electric furnace and oven;
- d. saws (including bandsaws);

- e. bench drill and grinder;
- f. bench sander and polisher;
- g. wax bath;
- h. various hand-held tools;
- j. bunsen burner;
- k. workbenches;
- m. storage cupboards;
- n. compressed air outlet;
- p. wall-mounted viewing boxes;
- q. telephone and computer workstation;
- r. plaster trap sink.

10.185 The construction and layout of equipment and work areas must meet the requirements of current health and safety regulations. Storage will be needed for tools. Facilities will be required for lifting heavy objects, for example an overhead rail and hoist.

10.186 Flooring should be non-slip and oil-resistant. Wall finishes should be robust.

10.187 Good natural and artificial lighting is required, with task lighting at workstations. Solar control and mechanical ventilation will be needed. An air extract system should be provided to remove fumes and dust caused by welding, sanding etc.

10.188 Access for deliveries by lorry should be considered.

10.189 A floor gulley will be required.

10.190 Storage shelves for smaller devices, spares and phantoms should be incorporated – metal racking would be suitable. Electrical sockets are required for those items needing to be charged.

### Dosimetry laboratory

10.191 Equipment will vary depending on local requirements but is likely to include:

- a. dosimetry system;
- b. bench-mounted oven for dosimetry work;
- c. safe;
- d. laboratory workbenches;
- e. storage cupboards;
- f. telephone and computer workstations.

## 11 In-patient facilities

### Assessment suite

- 11.1 Facilities may be provided for the assessment of patients for treatment-related toxicity and/or progression of disease symptoms. The patient's condition may have deteriorated while in the department or they may have been brought in as an emergency case. The patient may subsequently be admitted to a main ward.
- 11.2 The unit comprises a four-bed bay with workstations for medical and nursing staff and a controlled drugs cupboard.
- 11.3 Assessment units should be capable of delivering gender separation with the use of solid partitions as appropriate.

### Ward accommodation

- 11.4 Project teams should refer to the generic guidance on adult in-patient accommodation.
- 11.5 Patients suffering from cancer and undergoing cancer treatments often do not wish to eat at prescribed times. They may have very specific dietary requirements or difficulties with eating. Operational policies and the design of ward spaces and catering facilities should take this into account.
- 11.6 Rest rooms and refreshment facilities for visitors/ carers should be located nearby. Overnight accommodation may be required.

### Specialist in-patient accommodation

- 11.7 Treatment rooms for pulse dose rate brachytherapy and for unsealed source brachytherapy will be provided as part of the oncology in-patient accommodation, comprising specialised shielded bedrooms with shielded en-suites.
- 11.8 The en-suite facilities associated with these rooms must also feature a specially designed soil drainage system to cope with radioactive urine and faeces.

### PDR treatment room

- 11.9 The level of shielding required will depend on dose regimes. The nature and location of any windows must be the subject of a specific risk assessment at the planning stage, taking into account external adjacencies, occupation levels, and the intended scope and frequency of usage of the PDR equipment. The advice of local RPAs must be sought.
- 11.10 Intercom communication is required, along with CCTV for patient observation. Television monitors should be located so as to preserve privacy while permitting observation by nurses.
- 11.11 The control panel should be mounted in a secure location outside the treatment room and duplicated on the machine itself. The use of independent radiation monitors is advised.
- 11.12 See also [paragraph 10.8, 'Use of radiation'](#).

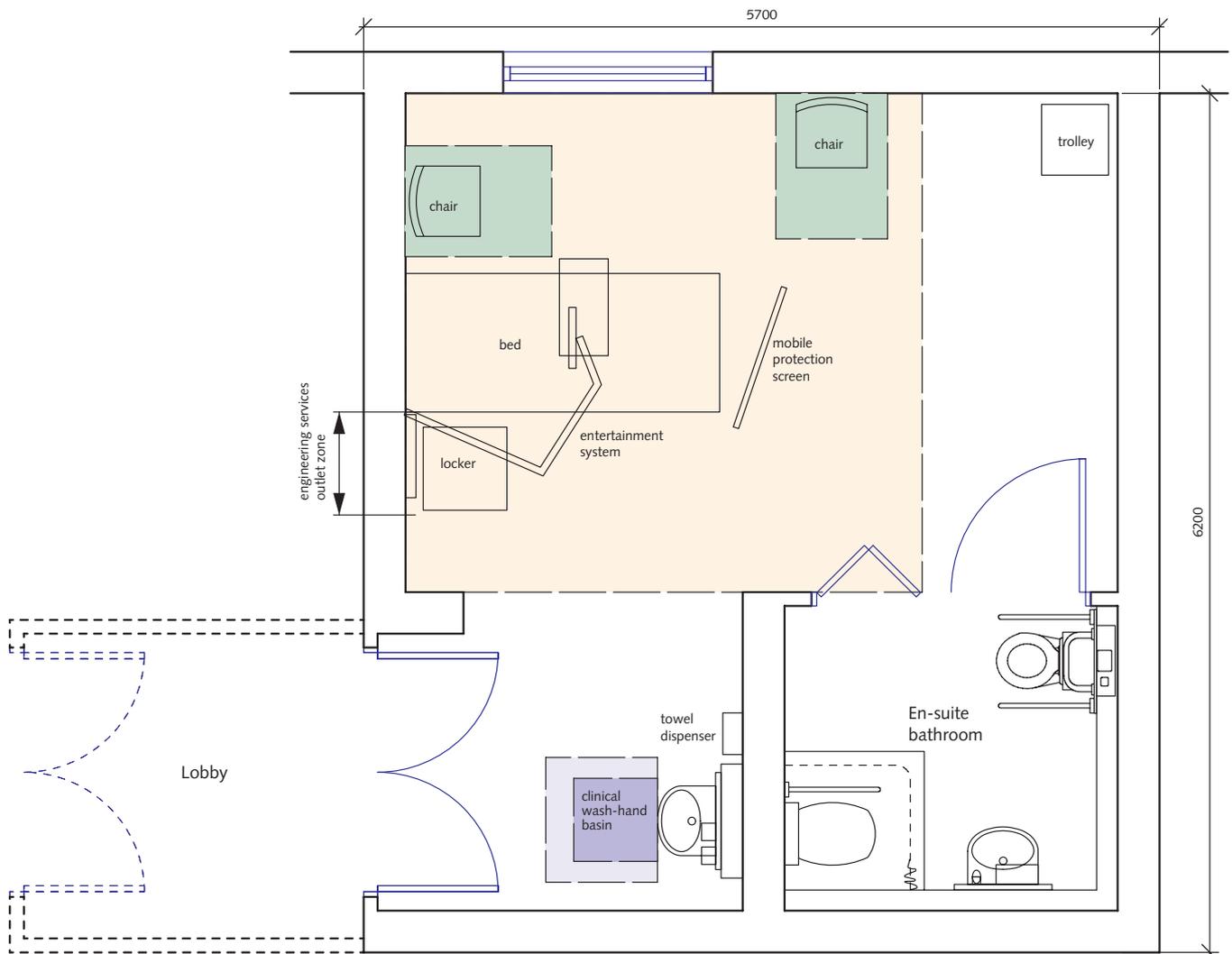
### Treatment room – unsealed source brachytherapy

- 11.13 The enclosing structure should be heavily shielded to prevent radiation passing from the room into the surrounding areas. It will typically consist of concrete in the order of 500 mm thick, with shielding doors, alongside use of electronic patient monitoring.
- 11.14 Good design and use of shadow shields will allow patients to have visitors on a limited basis and will allow greater contact with nurses. Some advanced designs also incorporate a window and use external shielding as a garden feature. This may require controlled outside access.
- 11.15 Intercom communication with the patient is required.
- 11.16 A washing machine, washing-up sink and clinical wash-hand basin for use by staff are required to help prevent spread of contamination.
- 11.17 Surfaces should be impermeable and easy to clean, with careful attention to jointing. Sinks should resist permanent contamination, particularly if

used for waste disposal. Wash-hand basins should be ceramic, with lever- or sensor-operated taps.

- 11.18 The risk of spillages (where radioactive drinks are used) and radioactive contamination influences the choice of surface finishes; for example, stainless steel is inappropriate due to the irremovable nature of iodine contamination.

- 11.19 Articles, materials or equipment that are contaminated with radiation will need to be collected in a shielded container and stored in a contaminated articles store until the radiation has fallen to a safe level.



Treatment room – unsealed source brachytherapy: example layout

## 12 Oncology operating theatres

- 12.1 Project teams should refer to the generic guidance on operating theatres (Health Building Note 26, 'Facilities for surgical procedures').
- 12.2 Particular attention should be paid to the need for mobile C-arm or image intensifier access and use. Special storage facilities for catheters, guide wires etc will be needed. These should be within or immediately adjacent to the operating room.
- 12.3 Where cervical and other Class 3 laser treatment procedures are undertaken, the guidance from the Medicines and Healthcare Products Regulatory Agency (MHRA) should be followed. This includes special power supplies for laser equipment, reduced use or elimination of polished surfaces, and the provision of window blinds, laser safety signs etc. The laser radiation protection advisor (LRPA) must be consulted on theatre design, the declaration of a laser-controlled area and the provision of warning lights etc.
- 12.4 See also DB 2008(03) 'Guidance on the safe use of lasers, IPL systems and LEDs'.

# 13 Engineering considerations

- 13.1 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 RPA.
- 13.2 All mechanical and electrical services entering rooms designed to contain radiation must be routed through specially-designed access ports so that shielding is not compromised. It may also be necessary to incorporate changes in the direction of ductwork, pipework and cable containment systems to provide protection against radiation breakout. In general, all services into linear accelerators will pass through the maze, with possibly an additional chicane for high-energy linear accelerators.
- 13.3 In treatment and simulation areas, plant and services access arrangements must not compromise the radiological protection provided for these rooms. Consideration should be given to the comfort and safety of patients as well as that of both clinical and maintenance staff.
- 13.4 In addition to any “permit to work” system (see ‘Space required for plant and distribution systems’ under ‘General’) it may be appropriate with low-level radiation hazard systems to use a “double knock” system whereby attempted unauthorised access to service areas at first initiates an audible warning and only when the access attempt is continued is radiation-emitting equipment switched off.
- 13.5 However, the hazard levels present with therapy equipment require a more stringent approach in which any intrusion will trigger beam shutdown.

## General

### Space required for plant and distribution systems

- 13.6 Particular care should be taken to ensure that where maintenance areas are subject to the effects of radiation and are not fully protected, for example

plant areas above radiotherapy treatment rooms, appropriate access control procedures including “permit to work” and warning lights are incorporated as part of the maintenance procedure.

### Design for safety

- 13.7 The Ionising Radiation (Medical Exposure) Regulations 2000 and associated codes of practice place onerous requirements upon engineering aspects of design and operational practices in cancer care facilities. There are additional requirements from the Radioactive Substances Act 1993 in respect of storage, use and disposal of radioactive materials. The RPA and custodian of radioactive substances must be consulted.

### Acoustics

- 13.8 Prolonged periods of silence or near-silence can be as distressing as noise to a patient undergoing cancer treatment. Consideration should be given to the provision of a source of low-level sound, for example background music, in treatment spaces such as radiotherapy treatment rooms.

### Commissioning of engineering services

- 13.9 It will be necessary to commission engineering services to radiotherapy treatment rooms, particularly those related to ventilation, prior to the installation and commissioning of radiotherapy equipment. Accordingly, appropriate integration of the building services commissioning schedule with the equipment supplier’s installation and commissioning schedule should be undertaken at an early stage.

## Resilience of electrical supplies

### Emergency electrical supplies

- 13.10 The emergency generator providing electricity in the event of a main supply failure should be capable of providing full (100%) back-up including air-conditioning and comfort cooling

plant serving specialist equipment such as linacs. If a new generator is to be installed, this should be the solution of preference.

- 13.11 In the event of a main supply or local final circuit failure, linear accelerator treatment rooms and escape routes should be illuminated by self-contained, battery-powered luminaires charged continuously from the main supply and capable of providing illumination for a period of three hours.

### Small power distribution systems

- 13.12 Systems in medical locations and associated areas should comply with the special requirements of BS 7671:2008 'Requirements for electrical installations. IEE Wiring Regulations' (17th edition) and the Institution of Engineering and Technology (IET) publication Guidance Note 7 'Special Locations' (3rd edition). The electrical supply connections to all medical electrical equipment should comply with BS EN 60601-1-2 'Medical electrical equipment. Particular requirements for the basic safety and essential performance of high frequency surgical equipment and high frequency surgical accessories'.
- 13.13 The earth connection at the power termination should be suitable for the functional earth requirements specified by the radiology equipment manufacturer and arranged to receive a direct connection from the earth reference terminal, which should be provided or designated in every radiotherapy treatment room.

## Mechanical engineering services

### Ventilation

- 13.14 The majority of areas within cancer facilities will require mechanical ventilation due to equipment heat gains, patient/staff numbers and for clinical/radiology reasons.
- 13.15 The possibility of excessive heat emission from equipment such as linear accelerators, and the special and often prolonged nature of radiotherapy procedures, will usually require that the air supply to radiotherapy treatment rooms be mechanically cooled.
- 13.16 Designers should consult with users, manufacturers and engineers to ensure an appropriate temperature is achieved. Where deep-planning of other continuously occupied spaces (for example linac/simulator control rooms or

linac bunkers) is unavoidable, there will also be occasions when acceptable levels of comfort can only be maintained by air-cooling.

### Ventilation cooling systems

- 13.17 Refrigeration loads for ventilation systems should be met either by the hospital's central water chiller plant or by packaged, remotely located, water chiller plant dedicated to the cancer facility. Direct expansion systems are not advocated unless the refrigeration load is small, since they can only be controlled in steps, unlike chilled water, which can be continuously modulated. Such equipment may be provided by the manufacturers of specialist equipment and should be considered differently from general ventilation cooling.

### Ventilation controls

- 13.18 The indicators for a system serving a particular space should be both immediately adjacent to the space and at a central staff base. For specialist equipment such as simulators/linacs, the indication should be located in the associated control room.

### Steam

- 13.19 The requirement for steam within the facility will be limited to humidification equipment associated with special ventilation plant to equipment spaces. If available, steam from the hospital's main supply should be used, subject to the requirement for clean steam as set out in Health Technical Memorandum 03-01 – 'Specialised ventilation for healthcare premises', Part A: Design and validation.
- 13.20 In the absence of a central steam supply, local steam generators, preferably powered from a firm gas supply, should be employed. Electrical generation of steam should only be considered in isolated instances where other forms of generation are unavailable.

### Drainage requirements – chemical and radioactive contaminated effluent

- 13.21 Providing that there is adequate dilution and the silver content has been effectively recovered, effluent can be discharged into the internal drainage system. Project teams are advised to establish the acceptable levels for silver and other processing chemicals at the planning stage of a scheme, as these are subject to change.

13.22 At an appropriate early stage in the design process, the project proposals for the collection and discharge of chemical and radioactive contaminated effluent should be discussed and verified with the local Radiation Protection Advisor and the local utility company responsible for the local authority sewerage system. Appropriate restrictions on access to drains and sewers likely to be discharging radioactive material must be implemented through “permit to work” type systems and locked drainage covers.

### Lighting systems

13.23 Consideration should be given to dynamic lighting control systems that alter the visual quality (but not the intensity) of light over the day to mimic natural daylight patterns and improve wellbeing. This is of particularly importance in areas without good natural daylight.

#### Lighting (treatment rooms)

13.24 For linear accelerators and some other treatment machines, automatic switching to low-level room lighting will be needed to facilitate the use of field marker lights and low-power alignment lasers. Conversely, high levels of lighting are needed for equipment maintenance.

#### Illuminated warning signs

13.25 At the entrance to each radiotherapy treatment room (except entrances used only by patients under the direct control of staff already inside the room, for example those from walk-through changing cubicles), an illuminated safety sign and a warning lamp must be provided in order to comply with the statutory requirements for radiological protection.

13.26 A further warning lamp must be provided in the treatment room.

13.27 The warning lamps must give a clear indication in red when they are energised, and the illuminated signs should incorporate the legend “Do not enter”, visible only when illuminated.

13.28 Other illuminated signs may also be required within the facility. All such signs should be connected to essential supplies where necessary. For therapy equipment, where exclusion of persons other than the patient is essential, the warning systems must work with interlocks and be specifically approved by the RPA.

### Fire detection and alarm systems

13.29 While fire detectors throughout the facility in general may be of the normal ionisation type, detectors within radiotherapy treatment rooms require special consideration.

### CCTV systems (medical)

13.30 CCTV should be provided where required to monitor patients undergoing treatment in restricted areas. The interference to which such equipment may be subject, such as radiation levels within the linac bunker, should be taken into account when it is specified, to ensure acceptable electromagnetic compatibility. Care should be taken in the positioning of monitors in order to preserve patient privacy.

### Patient/staff and staff emergency call systems

13.31 Particular care should be taken when choosing and siting call systems for use while a patient is undergoing treatment, for example within a linear accelerator.

## 14 Schedules of accommodation

- 14.1 The schedules of accommodation include the following examples:
- a. a chemotherapy service serving a population of 400,000;
  - b. a radiotherapy service comprising two linear accelerators;
  - c. a radiotherapy service comprising four linear accelerators.

Example schedules of accommodation for 'Cancer treatment facilities'								
ADB data for rooms without codes will be available later in the year								
					Cost guide allowances:	Circulation and communication	Engineering	
					Public	35.0%	25.0%	
					Clinical	35.0%	38.0%	
					Staff	35.0%	23.0%	
<b>Example 1: Chemotherapy service in an acute hospital</b>								
ADB code	Room name/function	Unit area allowance	Quantity	Net internal area	Circulation and communication allowance	Engineering allowance	Gross internal area	Notes
<b>Public spaces for chemotherapy unit</b>								
<b>Entrance, reception and visitors' facilities</b>								
J0232	Reception desk (size based on number of places)	5.9	2	11.0	3.9	2.8	17.6	2 places per unit
J1155/J1414	Waiting area: 25 places	2.25	25	56.3	19.7	14.1	90.0	Includes children's play area and 10% wheelchair places. 1 per treatment place (rounded to 25)
M0727	Interview room: 7 places	12.0	1	12.0	4.2	3.0	19.2	1 per unit
H1131	Information/resource area: 3 person	12.0	1	12.0	4.2	3.0	19.2	1 per unit
V1131	Nappy changing room	5.0	1	5.0	1.8	1.3	8.0	1 per unit
S0012	Infant feeding room	6.0	1	6.0	2.1	1.5	9.6	1 per unit
V1121	WC: semi-ambulant	2.5	2	5.0	1.8	1.3	8.0	1 per 12 waiting places
V0922	WC: independent wheelchair	4.5	1	4.5	1.6	1.1	7.2	1 per unit
<b>Clinical spaces for on-treatment suite</b>								
J1255/J1414	Waiting area: 6 places	2.25	6	13.5	4.7	5.1	23.4	Includes children's play area and 10% wheelchair places. 0.75 per clinical room
C0522	Examination/physical therapy room	12.0	4	48.0	16.8	18.2	83.0	1 per 100 000 population
C0237	Consulting/examination room: double sided couch	16.0	4	64.0	22.4	24.3	110.7	1 per 100 000 population
	Dispensary: non-chemotherapy drugs	8.0	1	8.0	2.8	3.0	13.8	1 per unit
T0535	Clean utility room	16.0	1	16.0	5.6	6.1	27.7	1 per unit
Y0431	Dirty utility room	8.0	1	8.0	2.8	3.0	13.8	1 per unit
T0211	Staff communication base (size based on number of places)	5.5	2	11.0	3.9	4.2	19.0	2 places per unit
M0727	Interview room: 7 places	12.0	1	12.0	4.2	4.6	20.8	1 per unit
W1594	Store: linen	3.0	1	3.0	1.1	1.1	5.2	1 per unit
W1584	Store: equipment and consumables	8.0	1	8.0	2.8	3.0	13.8	1 per unit
<b>Clinical spaces for chemotherapy treatment suite</b>								
X1500	Chemotherapy treatment: multi-chair bay	10.0	20	200.0	70.0	76.0	346.0	1 per 20 000 population
	Chemotherapy treatment: single room	12.0	4	48.0	16.8	18.2	83.0	1 per 100 000 population
	Chemotherapy preparation room	16.0	1	16.0	5.6	6.1	27.7	1 per unit
V0922	WC: independent wheelchair	4.5	4	18.0	6.3	6.8	31.1	En-suite to chemotherapy treatment single rooms
J1264	Parking bay: trolley/bed	4.0	2	8.0	2.8	3.0	13.8	2 per unit
T0535	Clean utility room	16.0	1	16.0	5.6	6.1	27.7	1 per unit
Y0431	Dirty utility room	8.0	1	8.0	2.8	3.0	13.8	1 per unit
T0211	Staff communication base (size based on number of places)	5.5	2	11.0	3.9	4.2	19.0	One staff base of 2 places provided per 6 chairs, as the open-plan space is to be subdivided into bays of no more than 6 for privacy and gender separation
T0211	Staff communication base (size based on number of places)	5.5	2	11.0	3.9	4.2	19.0	One staff base of 2 places provided per 6 chairs, as the open-plan space is to be subdivided into bays of no more than 6 for privacy and gender separation
T0211	Staff communication base (size based on number of places)	5.5	2	11.0	3.9	4.2	19.0	One staff base of 2 places provided per 6 chairs, as the open-plan space is to be subdivided into bays of no more than 6 for privacy and gender separation
V1121	WC: semi-ambulant	2.5	4	10.0	3.5	3.8	17.3	1 per 6 treatment places
V0922	WC: independent wheelchair	4.5	2	9.0	3.2	3.4	15.6	1 per 12 treatment places
V1635	Shower room: assisted	8.0	1	8.0	2.8	3.0	13.8	1 per unit
W1594	Store: linen	3.0	1	3.0	1.1	1.1	5.2	1 per unit
W1584	Store: equipment and consumables	12.0	1	12.0	4.2	4.6	20.8	1 per unit
W0274	Store: fluids	12.0	1	12.0	4.2	4.6	20.8	1 per unit
	Chemotherapy prep area	16.0	1	16.0	5.6	6.1	27.7	1 per unit
<b>Staff spaces: shared support</b>								
Y1510	Cleaners' room	8.0	2	16.0	5.6	3.7	25.3	2 per unit
P0625	Pantry/refreshment area	8.0	1	8.0	2.8	1.8	12.6	1 per unit
Y0646	Disposal hold: 3000 litres	12.0	1	12.0	4.2	2.8	19.0	1 per unit
G0180-01	Parking bay: resuscitation trolley	2.0	1	2.0	0.7	0.5	3.2	1 per unit
M0251	Office: 1-person	8.0	3	24.0	8.4	5.5	37.3	3 per unit
M0252	Office: 2-person	12.0	1	12.0	4.2	2.8	19.0	1 per unit
M0278/M0281/M0410/M0731	Admin area: shared use (size based on number of workstations)	6.6	6	39.6	13.5	9.1	62.6	6 places per unit
H11304-01	Seminar room: 10 places	19.0	1	19.0	6.7	4.4	30.0	1 per unit
D0434-01	Rest room with mini kitchen (size based on number of seats)	1.9	10	19.0	6.7	4.4	30.0	10 place per unit
V1010	WC: ambulant	2.0	1	2.0	0.7	0.5	3.2	1 per unit
<b>Total allowance</b>				<b>873.9</b>	<b>305.8</b>	<b>294.5</b>	<b>1474.2</b>	
<b>Optional accommodation</b>								
<b>Staff changing facilities (if not provided centrally elsewhere)</b>								
V0554-03/V0667/V0725/V1321	Changing area: staff (size based on number of lockers)	1.4	33	46.2				Includes uniform exchange area, showers and a number of individual changing rooms. Based on 30 staff who need a locker (allowing for shift changeover), plus a 10% contingency to allow for male/female split (suggested apportionment 2/3 female to 1/3 male)
V0725	Changing room: semi-ambulant	2.0	1	2.0				Additional individual changing room to allow for male and female segregation
V1321	Shower room: ambulant	2.5	1	2.5				Additional shower room to allow for male and female segregation
V1010	WC: ambulant	2.0	2	4.0				Additional WC to allow for gender segregation
Relationship of schedule to ADB room names								
Relationship of schedule to ADB for scalable rooms (ie those for which a recommended room size does not exist)								
Optional accommodation								
Circulation, communication and engineering services allowances								

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Example schedules of accommodation for 'Cancer treatment facilities'								
ADB data for rooms without codes will be available later in the year								
				Cost guide allowances	Circulation and communication	Engineering		
				Public	35.0%	25.0%		
				Clinical	35.0%	38.0%		
				Staff	35.0%	29.0%		
Example 2: Radiotherapy service in an acute hospital: two linear accelerators								
ADB code	Room name/function	Unit area allowance	Quantity	Net internal area	Circulation and communication allowance	Engineering allowance	Gross internal area	Notes
<b>Public spaces for radiotherapy unit</b>								
<b>Entrance, reception and visitors' facilities</b>								
J0232	Reception desk (size based on number of places)	5.5	2	11.0	3.9	2.8	17.6	2 places per unit
J1155/J1414	Waiting area: 15 places	2.25	15	33.8	11.8	8.4	54.0	Includes children's play area and 10% wheelchair places
H1131	Information/resource area: 3 person	12.0	1	12.0	4.2	3.0	19.2	
V1131	Nappy changing room	5.0	1	5.0	1.8	1.3	8.0	This space may be considered optional if facilities are provided centrally nearby
S0012	Infant feeding room	6.0	1	6.0	2.1	1.5	9.6	This space may be considered optional if facilities are provided centrally nearby
V1121	WC: semi-ambulant	2.5	2	5.0	1.8	1.3	8.0	1 per 12 waiting places. 2 provided for gender separation
V0922	WC: independent wheelchair	4.5	1	4.5	1.6	1.1	7.2	1 per unit
G0180-10	Parking bay: wheelchair	2.0	1	2.0	0.7	0.5	3.2	1 per unit
<b>Clinical spaces for on-treatment review suite</b>								
J1255/J1414	Waiting area: 6 places	2.25	6	13.5	4.7	5.1	23.4	Includes children's play area and 10% wheelchair places
X0145	Treatment room	16.0	1	16.0	5.6	6.1	27.7	1 per unit
C0237	Consulting/examination room: double sided couch access	16.0	2	32.0	11.2	12.2	55.4	1 per bunker
T0538	Clean utility room without controlled drugs cupboard	8.0	1	8.0	2.8	3.0	13.8	1 per unit
Y0431	Dirty utility room	8.0	1	8.0	2.8	3.0	13.8	1 per unit
T0211-01	Staff communication base (size based on number of places)	5.5	1	5.5	1.9	2.1	9.5	1 place per 2 bunkers
M0727	Interview room: 7 places	12.0	1	12.0	4.2	4.6	20.8	1 per unit
W1594	Store: linen	3.0	1	3.0	1.1	0.9	5.2	1 per unit
W1584	Store: equipment and consumables	8.0	1	8.0	2.8	3.0	13.8	1 per unit
<b>Clinical spaces for radiotherapy treatment suite</b>								
	Radiotherapy treatment room (bunker) and maze	160.0	2	320.0	112.0	121.6	553.6	The overall size has been determined on the assumption that the walls are concrete. The size will be less if using a modular block system. 2 bunkers per satellite unit
	Control area serving radiotherapy treatment room	20.0	2	40.0	14.0	15.2	69.2	1 per bunker
H0105	Radiographer prep room	10.0	2	20.0	7.0	7.6	34.6	1 per bunker
V0725	Changing room: semi-ambulant	2.0	2	4.0	1.4	1.5	6.9	1 per bunker
V0726	Changing room: independent wheelchair	4.5	2	9.0	3.2	3.4	15.6	1 per bunker
V0922	WC: independent wheelchair	4.5	1	4.5	1.6	1.7	7.8	1 per unit
J1255/J1414	Waiting area: 12 places	2.25	12	27.0	9.5	10.3	46.7	Includes children's play area and 10% wheelchair places. 6 places per linac
	Treatment planning room	5.0	8	40.0	14.0	15.2	69.2	4 places per bunker
	Radiotherapy physics room	12.0	1	12.0	4.2	4.6	20.8	1 per unit
<b>Clinical spaces for imaging suite</b>								
J1255/J1414	Waiting area: 6 places	2.25	6	13.5	4.7	5.1	23.4	Includes children's play area and 10% wheelchair places
V0725	Changing room: semi-ambulant	2.0	1	2.0	0.7	0.8	3.5	Dual access required. 1 per imaging room
V0726	Changing room: independent wheelchair	4.5	1	4.5	1.6	1.7	7.8	Dual access required. 1 per imaging room
V0922	WC: independent wheelchair	4.5	1	4.5	1.6	1.7	7.8	1 per imaging room
	Imaging room	33.0	1	33.0	11.6	12.5	57.1	1 per unit
	Generator room		1	0.0	0.0	0.0	0.0	Contained within engineering allowance
	Imaging control area	25.0	1	25.0	8.8	9.5	43.3	1 per imaging room
H0105	Radiographer preparation room	8.0	1	8.0	2.8	3.0	13.8	1 per imaging room
<b>Staff spaces: shared support</b>								
Y1510	Cleaners' room	8.0	2	16.0	5.6	3.7	25.3	2 per unit
P0625	Pantry/refreshment area	8.0	1	8.0	2.8	1.8	12.6	1 per unit
G0180-01	Parking bay: resuscitation trolley	2.0	1	2.0	0.7	0.5	3.2	1 per unit
Y0646	Disposal hold: 3000 litres	12.0	1	12.0	4.2	2.8	19.0	1 per unit
M0251	Office: 1-person	8.0	1	8.0	2.8	1.8	12.6	1 per unit
M0252	Office: 2-person	12.0	2	24.0	8.4	5.5	37.9	1.5 per bunker
M0278/M0281/M0410/M0731	Admin area: shared use (size based on number of workstations)	6.6	4	26.4	9.2	6.1	41.7	4 per bunker
H1313-01	Seminar room: 15 places	25.0	1	25.0	8.8	5.8	39.5	1 per unit
W1585-02	Store: general	8.0	1	8.0	2.8	1.8	12.6	En-suite to seminar room for flexibility in use of room
D0434-01	Rest room with mini kitchen (size based on number of seats)	1.9	10	19.0	6.7	4.4	30.0	5 places per bunker
V1010	WC: ambulant	2.0	2	4.0	1.4	0.9	6.3	1 per bunker
K0915	IT server room	6.0	1	6.0	2.1	1.4	9.5	1 per unit
W1584	Store: equipment and consumables	24.0	1	24.0	8.4	5.5	37.9	Stationery, equipment etc. 1 per unit
W1594	Store: linen	3.0	1	3.0	1.1	0.7	4.7	1 per unit
<b>Total allowance</b>				<b>937.7</b>	<b>328.2</b>	<b>318.2</b>	<b>1584.0</b>	
<b>Optional accommodation</b>								
<b>Staff changing facilities (if not provided centrally elsewhere)</b>								
V0554-03/V0667/V0725/V1321	Changing area: staff (size based on number of lockers)	1.4	33	46.2				Includes uniform exchange area, showers and a number of individual changing rooms. Based on 30 staff who need a locker (allowing for shift changeover), plus a 10% contingency to allow for male/female split (suggested accommodation 2/3 female to 1/3 male).
V0725	Changing room: semi-ambulant	2.0	1	2.0				Additional individual changing room to allow for male and female segregation
V1321	Shower room: ambulant	2.5	1	2.5				Additional shower room to allow for male and female segregation
V1010	WC: ambulant	2.0	2	4.0				Additional WC to allow for gender segregation
<b>Mould suite</b>								
	Impression and fitting	20.0	1	20.0				
V0726	Changing room: independent wheelchair	4.5	1	4.5				
V1323	Shower room: semi-ambulant: standing use	5.0	1	5.0				
	Workshop	35.0	1	35.0				
<b>Relationship of schedule to ADB room names</b>								
<b>Relationship of schedule to ADB for scalable rooms (ie those for which a recommended room size does not exist)</b>								
<b>Optional accommodation</b>								
<b>Circulation, communication and engineering services allowances</b>								



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	<b>Optional accommodation</b>					
N0317	Anaesthetic room	19.0	1	19.0		Required if children are attending
J1414-01	Play therapy room	20.0	1	20.0		Required if children are attending
J1264	Parking bay, trolley/bed	4.0	2	8.0		
	Assessment bay, 4 bed	64.0	1	64.0		
	<b>Radiotherapy treatment - superficial</b>					
	Superficial/orthovoltage radiotherapy room	30.0	1	30.0		It is recommended that this room is sized as an orthovoltage room; otherwise 21 sqm is required
	Control area serving superficial/orthovoltage treatment room	12.0	1	12.0		
	Machine room					The generator can be located in the control room
	<b>HDR brachytherapy</b>					
J1255	Waiting area, 6 places	2.25	6	13.5		Includes children's play area and 10% wheelchair places. With trolley wait, depending on local practice
J1264	Parking bay, trolley/bed	4.0	2	8.0		
T0535	Clean utility room	16.0	1	16.0		
Y0436	Dirty utility room	12.0	1	12.0		Based on a theatre dirty utility
V0922	WC, independent wheelchair	4.5	1	4.5		
	Brachytherapy treatment room and maze	68.0	1	68.0		
	Control area serving brachytherapy treatment room	12.0	1	12.0		
B2532	Recovery room, 2 patient	28.0	1	28.0		
	<b>Sealed source</b>					
W0610	Store, sealed radioactive source	6.0	1	6.0		
T0529	Prep area, sealed radioactive source	12.0	1	12.0		This space may be required to provide for local operational procedures where the sealed source is prepared in an isolator
	<b>Radiotherapy physics and technology</b>					
	Mechanical workshop and machine room	50.0	1	50.0		
	Dosimetry laboratory	28.0	1	28.0		
	Offices for radiation protection, research and imaging physicists		1			Quantum of provision to be determined locally
	<b>Staff support</b>					
V0554-03	Changing area, staff (size based on number of lockers)	1.4	33	46.2		Includes uniform exchange area, showers and a number of individual changing rooms. Based on 30 staff who need a locker (allowing for shift changeover), plus a 10% contingency to allow for male/female split (suggested apportionment 2/3 female to 1/3 male)
V0725	Changing room, semi-ambulant	2.0	1	2.0		Additional individual changing room to allow for male and female
V1321	Shower room, ambulant	2.5	1	2.5		Additional shower room to allow for male and female segregation
V1010	WC, ambulant	2.0	2	4.0		
	<b>Radiotherapy (PDR brachytherapy) facilities</b>					
X2062	Radiotherapy treatment room, PDR brachytherapy	29.5	1	29.5		Size includes thickness of concrete walls
V1631-01	Shower, WC and wash, radiation-protective	5.5	1	5.5		
	<b>Radiotherapy (unsealed source) facilities</b>					
	Radiotherapy treatment room, unsealed radioactive source	29.5	1	29.5		Size includes thickness of concrete walls
	Lobby	5.5	1	5.5		
	Shower, WC and wash, radiation-protective	5.5	1	5.5		
Y0661	Hold, disposal, radioactive waste	2.0	1	2.0		
	<b>Relationship of schedule to ADB room names</b>					
	<b>Relationship of schedule to ADB for scalable rooms (ie those for which a recommended room size does not exist)</b>					
	<b>Optional accommodation</b>					
	<b>Circulation, communication and engineering services allowances</b>					

# 15 References

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