CANCER PEDIA

CORE SERVICES/INFRASTRUCTURE

PHYSICAL FACILITIES DESIGN AND MANAGEMENT

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CHAPTER

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PHYSICAL FACILITIES DESIGN AND MANAGEMENT

A. INTRODUCTION

Cancer centres require physical facilities that foster a healthy environment. By using the principles of evidence-based design, physical facilities can enable a safe, positive and therapeutic experience for patients and the healthcare team, and contribute to improved health outcomes.

Physical facilities should be thoughtfully planned with a view to current and future needs, meet best practice standards and guidelines, and be properly maintained to support a well-functioning cancer centre. Poor physical facilities and support services can paralyze the best clinical services.

In addition to the general physical facilities that enable a whole organization, each cancer service has specific requirements. These requirements exist regardless of whether the cancer service is located in a specialized, stand-alone cancer centre or in a larger, full-service hospital that provides cancer care. For more information about the physical facilities requirements of each clinical cancer service, see the appropriate *Cancerpedia* chapter.

This chapter presents the key elements of physical facilities in a cancer centre, as well as the guiding principles, standards and guidelines, resources, processes and structures that enable ongoing physical facilities planning, design and operations. It is most relevant to existing cancer centres that are seeking to redevelop, renovate and maintain facilities in accordance with best practices and future trends. Detailed information on the planning and construction of new hospitals can be found through various international and national standard-setting bodies, as discussed below, and in the World Health Organization's *District Health Facilities: Guidelines for Development & Operations*. [1] This document details the various stages of planning and designing a hospital, including establishing demand for a new hospital, preparing a design brief, design, construction and commissioning.

B. OVERVIEW

Physical facilities include buildings, their internal configuration, building support systems and major equipment.

In a cancer centre, ***buildings*** include structures that house the centre's operations, including its clinical services, support services, administrative services, parking, etc.

The ***internal configuration of buildings*** includes:

- Patient and family areas, such as admitting and registration, waiting rooms and lounges, inpatient rooms, outpatient clinic rooms, gym and wellness centres, washrooms, etc.
- Clinical cancer service areas, such as medical imaging, laboratory medicine and pathology, surgery, chemotherapy, radiotherapy, supportive care and palliative care.
- Clinical support service areas, such as emergency care services, pharmacy, and infection prevention and control.
- Non-clinical service areas, such as patient call centres, health records storage, information technology, nutrition and food services, laundry services, central sterile supply, clean and

soiled supply, equipment holding areas, biohazardous waste holding areas, the morgue, etc.
- Public areas, including lobbies, cafeterias, vending areas, retail space, libraries for patient and public education, hallways, etc.
- Staff areas, including offices, clinical staff work rooms, meeting rooms, resource libraries, departmental lounges, lockers and coat rooms, storage space, etc.
- Education areas, such as classrooms, simulation training space, etc.
- Research areas, such as offices, laboratories, meeting rooms, etc.

Building support systems include power supply and backup, heating and ventilation, plumbing, mechanical systems, waste disposal, emergency management and command centres, etc.

Equipment includes all clinical cancer services equipment and supplies, telecommunications and switchboards, non-clinical materials and supplies, research and education equipment, furniture, etc. For more information, see the *Cancerpedia: Equipment and Technology* chapter.

C. REQUIREMENTS

1. PLANNING FOR REDEVELOPMENT OR RENOVATION

Decision-makers must go through a number of steps based on a set of guiding principles to plan well-functioning physical facilities. Master planning supports the execution of the cancer centre's strategy and addresses both present and future needs. It indicates what physical facilities will look like, how care will be provided and how to best organize the internal configuration of the cancer centre to enable services. Functional planning identifies specific requirements to support the services and programs of various departments.

Guiding Principles

There are a number of guiding principles for the planning, design and development of physical facilities. The major guiding principles are described below.

Principles that reflect ***evidence-based design*** embrace best practices in design and construction that result in healthcare-related improvements. For example, the use of sound-absorbing construction materials, hand sanitizing areas and sinks in every patient room, maximum natural light, decentralized nursing stations with optimum visibility and accessibility to patient rooms, and standard design and equipment in every room have resulted in positive feedback and benefits for patients, families and the healthcare team. [2] The Center for Health Design demonstrates the value of design for improving health outcomes, the patient experience, and healthcare team satisfaction and performance. [3]

Principles that reflect ***accessibility and diversity*** aim to create an inclusive environment that meets the physical and psychosocial needs of every patient. Examples include ramps for individuals with mobility aids or assistive devices for patients with sensory impairments.

Cultural and gender sensitivity may be taken into account through, for example, spaces for worship or private areas for men and women.

Principles that support ***flexibility and future growth*** result in adaptable and convertible physical facilities that optimize the use of the space and enable future adjustments, as necessary. Examples include planning zones for growth or robust utilities that can be easily expanded and upgraded. [4]

Principles that guide ***space and service location decisions*** help to maximize the use of space and ensure that services or departments with dependencies or close working relationships are in proximity to each other. This includes developing ideal flow patterns to support optimal circulation routes. It also includes designing spaces that meet the needs of unique patient populations and that support privacy and confidentiality.

Principles related to ***safety and security*** result in physical design and materials that support infection prevention and control, workplace health and safety, and safe patient care. For more information, see the *Cancerpedia: Infection Prevention and Control* chapter.

Green principles – such as those reflected in Leadership in Energy and Environmental Design (LEED) standard – provide guidance for the design, construction, operation and maintenance of buildings that use resources efficiently and are environmentally responsible. [5, 6]

Principles that support ***patient-centred healing*** focus on the environment as integral to the healing process. Examples of healing elements in patient rooms include a comfortable place for the family, sinks, and control over lighting, temperature and airflow. [7] Other examples of healing elements are fountains or water features, gardens and alcoves for private conversations. [8]

Master Planning

Effective master planning is a roadmap that translates the cancer centre's vision and strategy into a broad picture of physical facilities, while allowing for flexibility and future growth. A high-quality master plan considers the optimal phasing and grouping of individual buildings, internal building configuration, access and circulation routes, and the effective functioning of various services. The master plan may be updated as new needs arise. Detailed considerations for master planning can be found in World Health Organization's *District Health Facilities: Guidelines for Development & Operations*. [1] Some elements are included below.

The cancer centre must develop ***site plan and utilization*** diagrams to document the location of buildings, their entrances and exits, and the location of utilities. Site planning and utilization takes into account traffic and pedestrian flow for optimal access routes and circulation. These diagrams should be retained to enable the location of important building structures for the purposes of renovation and maintenance.

Cancer centres should comply with all applicable ***building codes*** in their jurisdiction. Local standards authorities or international review can help to provide context on appropriate standards for healthcare facilities. Given their unique and immunocompromised patient population, cancer centres should be designed to a high standard and go above and beyond applicable building code requirements, where possible.

Within buildings, high-level ***space requirements*** must be determined for each proposed program, service and department. Decisions regarding space requirements are based on the centre's model of care, volumes of activity, staffing and other factors. A cancer centre that is part of a larger hospital can leverage clinical and non-clinical corporate-wide services. The internal configuration and layout of spaces within buildings are determined as part of this decision-making process, taking into account the need for departmental working relationships, service adjacencies, patient and staff flow, and wayfinding.

Functional Planning

Functional planning results in detailed physical facility requirements for each proposed program and service. This may include planning for clinical service space, staff areas, and patient and family areas, and the accommodation of major equipment, furniture and building support systems. Non-clinical service areas – such as nutrition and food services, housekeeping and laundry services, administrative areas, research and education areas, and public areas (e.g., lobbies, cafeterias) – are also included. Functional planning takes into account the need for direct and convenient departmental and clinical support service area relationships and adjacencies to support staff and patient flow. Most jurisdictions have standards and guidelines for health service space requirements. Detailed considerations for functional planning can be found in World Health Organization's *District Health Facilities: Guidelines for Development & Operations*. [1]

Functional planning occurs on an ongoing basis. Integrated modalities tend to have spatial and servicing requirements that supersede current and previous standards. This is a factor to consider during the planning phase, so that appropriate considerations are made for the integration of future modalities that will be larger and more infrastructure-intensive than current modalities. The transportation of heavier and larger equipment through corridors and access points should also be considered in functional planning.

2. Standards and Guidelines

Physical facilities must meet best practice standards and guidelines for approval to redevelop or renovate, and for building design.

Approval to Redevelop or Renovate

Approval to redevelop or renovate standards vary by jurisdiction and usually include local zoning requirements and impact assessments. For example, standards may require that:

- The purpose of the building complies with the approved use for the property
- The proposed site can be accessed

- Impacts have been identified and addressed, such as: environmental impacts (e.g., soil tests, water table range); historical impacts (e.g., the site's heritage status, historical or cultural context); aviation flight path impacts (e.g., air rights); and the expected demand on current utilities and services (e.g., electricity, plumbing, water and sewage)

Building Design

International standards exist for building design, many of which have been adopted and/or adapted by other jurisdictions. The International Organization for Standardization (ISO) develops standards for the construction sector. [9]

National and subnational organizations (e.g., the Canadian Standards Association [10] may set standards and guidelines specifically for physical facilities related to cancer care. These typically include, but are not limited to, requirements in the following areas:

- Construction specifications for safe buildings
- Sizing benchmarks for specific service areas and facilities
- Environmental protection
- Fire protection
- Electrical systems and backup safety
- Heating, ventilation and air conditioning systems and safety
- Plumbing systems
- Wayfinding
- Acoustics
- Facilities that ensure patient and family, staff and public safety
- Infection prevention and control (for more information, see the *Cancerpedia: Infection Prevention and Control* chapter)

Other international organizations address specific facility requirements for clinical services; for example, the International Atomic Energy Agency provides requirements for medical imaging and radiotherapy. [11] Service-specific physical facility standards and guidelines can be found in other *Cancerpedia* chapters.

Detailed considerations for the approval and design of buildings can be found in World Health Organization's *District Health Facilities: Guidelines for Development & Operations*. [1]

3. Facilities Management

Facilities management should be considered in the planning and design of physical facilities to ensure optimal functioning of the cancer centre. Facilities management involves various elements that aim to:

- Maintain a healthy and safe physical environment for staff, patients and families, and the community
- Ensure the operations and maintenance of structural and architectural elements and equipment
- Prevent and predict equipment failures
- Reduce downtimes

- Manage assets
- Track costs

It may also include the teams or structures that are responsible for infrastructure renewal, replacement and redevelopment.

Below are some elements that may fall under facilities management. For more information, refer to the World Health Organization's *District Health Facilities: Guidelines for Development & Operations*. [1]

Security

Security services are responsible for ensuring the overall safety and security of the hospital. This includes the protection of the hospital and its property as well as the protection of patients and families, staff and their property. Security guards require adequate training to deal with adverse events and situations. The security team also requires appropriate space and may require a telecommunications infrastructure to carry out its duties. The International Association for Healthcare Security and Safety provides detailed information on international security design guidelines for healthcare facilities. [12]

Transportation

Transportation services ensure the timely and efficient movement of patients, materials, supplies and equipment between different areas of the hospital, or between hospitals in a multi-site organization. Examples of transportation services include the movement of specimens, drugs, linen and laundry, pumps and stretchers, and wheelchairs, as well as patient portering. From a design perspective, corridor routes should be able to accommodate transportation needs (e.g., trolleys, stretchers, medical equipment).

Telecommunications

Telecommunications services enable the effective and efficient sharing of information, both within the cancer centre and externally. Telecommunications systems include internal and external telephones, intercoms, emergency alarms, patient call buttons, a public address system, a mailroom and mail delivery, and access to radio and television, the internet, email and video conferencing. For more information about the requirements for telecommunications services in a cancer centre, see *Communication Systems in Healthcare*. [13]

Nutrition and Food

Patients require optimal nutrition and hydration for a healthy recovery. [14] Nutrition and food services typically plan, prepare, assemble and deliver meals to patients. Where possible, the service should aim to provide healthy choices based on the dietary and medical needs of the patient. [15]

The nutrition and food services team may include nutritionists, dietitians and food service staff. If the service is centralized within a cancer centre, the movement of large food trolleys in corridor routes should be considered in facilities planning and design. If the service is decentralized to departments or units, satellite kitchens are necessary for the preparation, cleaning and storage of food, utensils and equipment. For more information about nutrition and food services, see *Food and nutritional care in hospitals: how to prevent undernutrition–report and guidelines from the Council of Europe*. [16] For more information about food safety, see the *Cancerpedia: Infection Prevention and Control* chapter.

Housekeeping and Laundry

Housekeeping services manage a wide range of critical activities that contribute significantly to maintaining hospital facilities, equipment and supplies, and preventing and controlling infection. These activities include: [17]

- Cleaning patient care areas and rooms every day (e.g., beds, examination tables, furniture, floors)
- Cleaning equipment
- Cleaning staff working areas and public areas
- Changing, collecting and transporting bedding and linen
- Collecting and transporting waste, including sharps
- Caring for and storing clean supplies
- Attending to utility rooms

Linen and laundry services manage the procurement, washing, cleaning, disinfection and distribution of linen and laundry to all areas of a cancer centre. This includes all textiles used in a hospital, such as bed covers, pillow covers, blankets, sheets, towels, gowns, mattresses and scrubs. Linen and laundry services may be insourced or outsourced, depending on the needs of the cancer centre. The service should provide a clean, safe and efficient supply of linen and laundry to promote patient care and reduce the risk of cross-contamination.

For more information about cleaning best practices, see Public Health Ontario's *Best Practices for Environmental Cleaning for Prevention and Control of Infections in All Health Care Settings, 3rd Edition*. [17]

Water, Sanitation and Waste Management

Water, sanitation and waste management services ensure the provision of an adequate waste disposal systems and a safe, potable water supply. Facilities design must account for the need to segregate clean goods from used and contaminated goods. There are a variety of healthcare waste categories to consider, including infectious waste, sharps, pharmaceutical waste, chemical waste, pressurized containers and general waste. In jurisdictions where comprehensive and efficient water and waste management systems are not available, designers must find other flexible solutions to reduce the risk of infections and water- or food-borne diseases. For more information, see the World Health Organization's health-care facilities and waste resources. [18]

Disinfection and Sterilization

Disinfection and sterilization services ensure that the equipment, instruments and dressings that come into contact with patients are sterile. Healthcare facilities require a sterile supply area or disinfection and sterilization unit. Effective sterilization can be provided by steam under pressure, using an autoclave or even a simple pressure cooker. Some hospitals may have a more complex medical device reprocessing area to clean, decontaminate, inspect and sterilize all medical equipment. For more information, see the *Cancerpedia: Surgery* and *Cancerpedia: Infection Prevention and Control* chapters.

Engineering

The role of engineering services is to optimize the reliability and efficiency of cancer centre operations. Engineers and their support personnel ensure the inspection, maintenance and repair of facilities, equipment and services. They may be trained in a variety of disciplines, including mechanical, electrical, civil, systems or biomedical engineering. Mechanical engineering addresses elements such as energy sources, water, steam services, heating, ventilation and air conditioning systems, medical gas services and fire protection systems. Electrical engineering addresses elements such as electricity supply and distribution, interior and exterior lighting, earthing, substations and standby plants. Civil engineering addresses the planning, design and building of physical facilities and infrastructure. Systems engineering addresses the operational management, reliability and logistics of physical facilities and infrastructure. Finally, biomedical engineering addresses elements of biological and medical systems, products and devices. Biomedical engineers are specifically trained to maintain and manage medical equipment. For more information, see the *Cancerpedia: Equipment and Technology* chapter.

Administration

The administration leads and supports clinical operations and as well as non-clinical functions, such as finance, information technology and human resource management. Administrative spaces may include offices, meeting rooms, convertible and flexible multi-use spaces, workstations, and an audiovisual infrastructure for effective communication. Staff, patient and family education and training support may also be offered in convertible multi-use spaces, such as classrooms. For more information about service-specific administrative space requirements, see the appropriate *Cancerpedia* chapter.

4. Processes and Structures

Physical facilities require ongoing processes, structures and funding for efficient operations, maintenance, upgrades and replacements.

Supply Chain Management

Supply chain management includes purchasing and ordering, logistics and inventory management, contract management and vendor performance management related to the

resources, supplies, goods and services delivered to patients and providers. In many jurisdictions, supply chain management is fragmented and inefficient, resulting in significant costs that could be otherwise reinvested into patient care. Robust and agile supply chains can provide significant cost savings and result in the improved quality of patient care.

There are various strategies that can be used to optimize the healthcare supply chain. For example, value-based procurement considers value to the system (e.g., quality, life cycle and patient outcomes) in purchasing decisions, in addition to costs and technical factors. The use of value-based procurement is linked to improved patient outcomes and increased integration in the delivery of products and services. Organizations may also consider consolidating contracts for all medical equipment to increase buying power and adopting innovative practices to achieve operational efficiency. [19]

Preventative Maintenance

The resources required to install and maintain the mechanical and electrical components of a hospital can be significant. Appropriate design and planning should consider maintenance costs and needs to ensure that they are compatible with local resources.

Some examples of processes and structures for ongoing operations and maintenance include:

- Assessing all physical facilities regularly to ensure they are meeting the needs of patients and staff, and supporting effective, efficient and safe operations
- Maintaining an updated list of all medical equipment, along with maintenance and replacement schedules that align with the standards set by manufacturers and/or associations
- Ensuring that all facilities and equipment are in good working order, regularly maintained according to standards, and upgraded or replaced as required

A number of sample checklists and schedules for planned preventative maintenance are available in the World Health Organization's *District Health Facilities: Guidelines for Development & Operations.* [1]

Fire Safety

All areas should be in compliance with appropriate fire codes to minimize death, injury, loss and damage to property. Principles of fire safety to consider include: fire avoidance, fire growth restriction, fire containment, fire detection, fire control, smoke control and escape provisions. To address fire safety, organizations may consider protective devices in buildings and structures, fire protection appliances, facilities to stop fire and smoke, fire doors, the maintenance of fire exits and the use of fire-resistant materials in construction. Organizations may also consider fire prevention and response training for staff to increase education and awareness of fire safety. For additional information, see the World Health Organization's *Building security and fire protection* report. [20]

D. THE FUTURE

A number of key trends will influence the design and management of physical facilities into the future, as described below.

Increasingly, cancer care is being provided through ***outpatient care models***, rather than through inpatient care. Cancer centres will see design priorities shifting from traditional inpatient rooms to highly-functional outpatient spaces. ***Hotelling*** – the use of clinic space for multiple purposes – has the potential to reduce the amount of overall space required to deliver clinics.

In terms of clinic and patient room design, ***safe design*** is helping to maximize patient safety. It includes a broad range of physical facility enhancements, including lighting, acoustics, mobility aids and lifts, wall and floor surfaces, the positioning of furniture and equipment, and standard room layouts. ***Point of care testing*** (POCT) – which includes selected pathology testing at the bedside or in outpatient clinics, as well as X-rays and ultrasounds conducted in patient rooms using mobile and handheld equipment – is reducing the demand on medical imaging suites and physical laboratories, while simultaneously requiring the design of patient care spaces to accommodate portable equipment. Finally, ***smart technologies*** – such as smart rooms, smart walls, smart phones and tablet applications – are enabling communication, quick access to information and decision-making support through digital technology. Smart rooms may have technologies such as interactive touch screens or ultrasound badges that provide a patient's data to the appropriate provider on their smart phone, tablet or computer monitor when they enter the room. Smart walls are virtual, interactive white boards, where patient information can be entered and retrieved alongside protocols, tools or checklists for care. These innovations require sufficient space and investments in new technologies.

Beyond patient care areas, ***virtual navigation guides*** are providing wayfinding support through smart phone applications (or "apps") and helping to alleviate stress on patients and visitors. These apps direct users through the building based on their indoor location using a global positioning system (GPS), and provide suggestions and information about appropriate parking, hospital entrances and the location of clinics or appointments. Apps may be customized to provide a platform for deeper engagement with users, providing relevant information based on the needs of the individual accessing the app. Analysis of information from these virtual guides may enable hospital leadership to gain insights into how facilities are being used, and guide decision-making as to where staff and amenities should be located.

Additionally, ***kiosks*** are increasingly being used in healthcare facilities for multiple purposes, such as helping patients and visitors navigate the hospital, access information and education on health topics, check-in for appointments or complete surveys (e.g., screening surveys for symptoms and anxiety). Kiosks can also be used to check blood pressure, take a patient's weight and height, and provide information on appointments and programs. Although kiosk space should be incorporated into physical design, kiosks generally require less space than reception desks and large information and education displays.

Beyond the cancer centre, ***telemedicine*** applications are becoming more advanced and useful for supporting patients closer to their local communities. Although telemedicine has been around for quite some time, it continues to be critical for linking cancer centres with facilities that do not have a specialized physical infrastructure and expertise. More sophisticated telemedicine stations and connections should be incorporated into physical facilities design to support highly-specialized diagnostic consultations.

In terms of hospital management, increasingly sophisticated, integrated and computerized ***building management systems*** are being used to control equipment, heating, ventilation and air conditioning, security systems, power systems and lighting. The use of building management system can enable resource efficiency and automation, resulting in improved reliability, flexibility and cost savings. In some areas, particularly in tropical climates, ***solar energy*** may also be used to provide an almost maintenance-free source of supplementary energy. Low-cost solar heating devices can be beneficial in areas that need a constant supply of hot water, such as laundry services, kitchens and inpatient units. Finally, ***inventory management*** solutions are being developed and adopted from other industries to improve efficiency in supply chain management. For example, just-in-time inventory strategies reduce waste and increase efficiency by receiving goods only as they are needed. Just-in-time practices require sophisticated demand forecasting and are sensitive to disruptions in the supply chain; however, if managed well, they can result in significant cost savings and efficiencies.

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