CANCER PEDIA

CLINICAL SERVICES

SURGERY

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CHAPTER
10

SURGERY

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A. INTRODUCTION

Cancer surgery is an integral part of cancer treatment. The vast majority of cancer patients have a surgical procedure to diagnose or treat their cancer. Surgery often offers cancer patients the greatest chance for a cure, especially in the case of solid tumours, and is essential for both survival and the management of complications.[2-4]

This chapter presents the essential elements required to establish and implement a comprehensive cancer surgery service as part of a cancer centre or program.

B. CLINICAL SERVICES

1. GOALS [5-8]

Reducing the Risk of Cancer

Prophylactic surgery removes body tissue or organs at high risk of developing cancer. Individuals at high risk of cancer due to inherited conditions may undergo preventive surgical procedures (e.g., removal of precancerous polyps in the colon or uterus, removal of breast and ovarian tissue in those who have harmful mutations of the BRCA1 or BRCA2 gene).

Diagnosis of Cancer

Diagnostic surgery – or biopsy – removes or samples tissue suspected of having cancer. The tissue is then examined in the laboratory to determine the presence of cancer and to identify the type of cancer. See the *Cancerpedia: Laboratory Medicine* and *Pathology* chapter for more information.

Biopsy procedures are often conducted by surgeons, but may be carried out by other specialists such as interventional radiologists. They vary in intensity and invasiveness and may require local or general anaesthesia. Biopsy procedures include the following:

- ***Fine needle aspiration biopsy*** uses a very thin needle attached to a syringe to retrieve tissue. The needle can be guided into a tumour using ultrasound or CT (computed tomography).
- ***Core needle biopsy*** uses a larger needle and usually retrieves a larger amount of tissue to support laboratory testing. Ultrasound or CT may be used to guide the needle.
- ***Endoscopic biopsy*** uses a scope with a viewing lens or video camera and light to visually identify any tumours in the area. Some endoscopes have ultrasound devices attached, which enable pictures to be taken.
- ***Excisional or incisional biopsy*** involves the surgeon removing a whole or partial tumour, respectively.

See the *Cancerpedia: Medical Imaging* chapter for more information.

Assessment of Disease Extent

The size and spread of cancer in the body may occasionally be determined with the help of exploratory surgery. Preferably, imaging scans and other tests are used, but there are instances when surgery is required to assess the disease extent.

Surgical procedures to stage cancer include the following:

- ***Laparoscopy*** involves making a small incision in the abdomen and inserting a laparoscope to look for suspected cancer, determine the size of a tumour or assess the spread of cancer. A biopsy can be taken through the laparoscope.
- ***Open surgical procedures*** are used when less-invasive techniques do not give enough information about the type and extent of cancer. For example, a laparotomy enables the surgeon to examine the interior of the abdomen fully and take biopsies; a thoracotomy focuses on the chest area.

Definitive Resection of Cancer

Surgery is one of the main treatments for solid tumour cancers. For early stage cancer that is localized and has not spread, surgery may be the only treatment needed to cure cancer. Cytoreductive surgery is sometimes used to remove only part of a cancerous tumour or to reduce its bulk.

Supporting Other Therapies

Some surgical procedures are conducted solely to support the delivery of other cancer therapies. For example, a vascular access device can be surgically inserted into a large vein to give chemotherapy and draw blood.

Restoring Function or Appearance

Individuals who have had parts of their body removed due to cancer may have restorative or reconstructive surgery to restore function or appearance. Examples include: ostomies, which create openings to eliminate bodily wastes after colorectal cancer; tissue flaps, bone grafts and prosthetics to reconstruct facial features after head and neck cancer; and breast reconstruction after mastectomy.

Control of Symptoms/Palliation

Surgery can relieve the symptoms or side-effects of cancer to improve the patient's quality of life and extend life, rather than cure cancer. For example, surgery can remove a tumour that is pressing on a nerve, organ or bone, or blocking an organ, such as the bowel, resulting in pain, discomfort and unnecessary sickness.

2. SURGICAL SPECIALTIES

A cancer centre should provide a full range of surgical and cancer subspecialty services, either on-site or in partnership with another centre on a consulting basis. These services include:

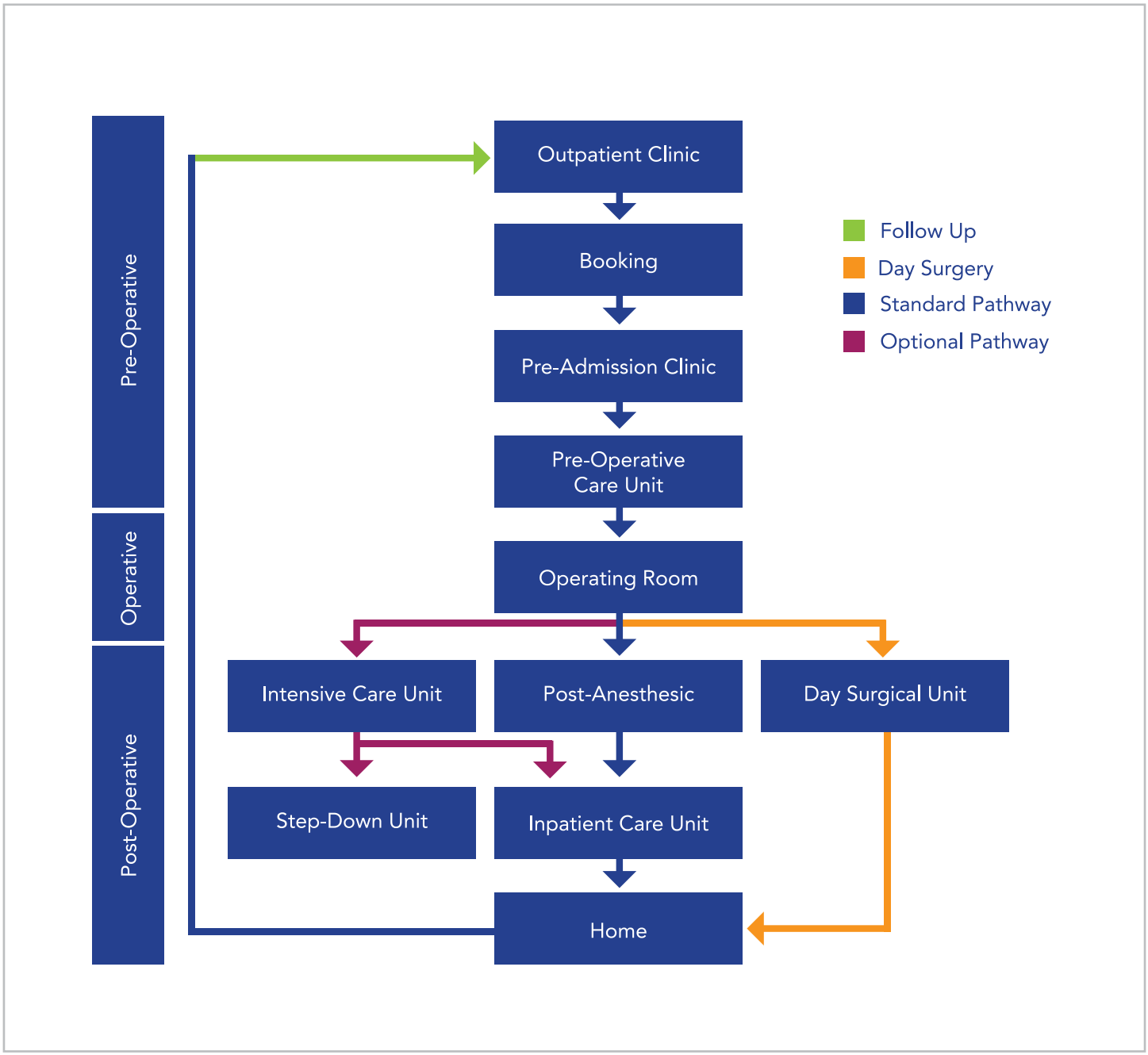
- ***General surgery***: This surgical specialty has become more subspecialized in a number of cancer-related areas, such as cancers of the breast, hepatobiliary system and pancreas, colon and rectum, endocrine system, soft tissue and retroperitoneum, and skin.
- ***Gynecologic surgery***: Gynecologic oncologists use open and minimally invasive techniques for gynecologic tumours, major abdominal surgery for metastatic ovarian cancers, and local extirpation of vulvar malignancies.
- ***Neurosurgery***: Neurosurgeons are trained to perform surgery where cancer affects the nervous system (i.e., brain, spinal cord, peripheral nerves).
- ***Ophthalmologic surgery***: As ophthalmologic cancers are relatively rare, a specifically trained ophthalmologist is required to address malignancies of the eye and eyelid.
- ***Orthopedic surgery***: Expertise is required for oncologic limb surgery with limb preservation techniques, and specialized pelvic surgery.
- ***Otolaryngology/head and neck surgery***: Head and neck tumour surgery may be performed by specialists in otolaryngology/head and neck surgery, general surgery, plastic surgery or a combination of these specialties, depending on the location of the tumour.
- ***Skull base surgery***: Surgical specialists in vascular surgery and plastic surgery collaborate with head and neck surgeons and neurosurgeons in the specialized field of skull base surgery.
- ***Plastic surgery***: Specialized expertise in plastic surgery is required for cancer patients who need comprehensive reconstructive surgery that uses microsurgical techniques (e.g., free-flap reconstruction and breast augmentation techniques). A plastic surgery service may also manage primary cutaneous tumours (e.g., malignant melanoma, basal cell or squamous cell carcinoma).
- ***Thoracic surgery***: Thoracic surgery includes major lung and esophageal resections, advanced lung preservation maneuvers, endobronchial diagnostic procedures, esophageal procedures, and tumours of the thymus and pleura.
- ***Urologic surgery***: Urology addresses renal, prostate, bladder and testicular cancers, each of which usually require surgeons who have specialized expertise in one area.
- ***Vascular surgery***: Many surgical patients in a cancer centre require specialized vascular surgical expertise (e.g., major resections needing vascular restoration procedures).
- ***Cardiac surgery***: Cardiopulmonary bypass may be required for occasional renal and hepatic cancer operations, and some supradiaphragmatic tumours.

Each surgical specialty requires an appropriate infrastructure and human resources, along with a critical mass of patients to ensure quality and maximize the effective and efficient use of resources. Compared to more common cancers, less common cancers may require highly-specialized equipment and instrumentation and highly-sophisticated clinical expertise. These resources should be centralized in larger centres, where possible. Smaller centres that are unable to support the full range of surgical and cancer subspecialty services must be prepared to facilitate access to these services. This is also true of larger general hospitals, many of which perform surgery for more common cancers due to the fact that these cancers are widely prevalent in the population. All surgeons are trained to treat various diseases, including more common and less complex cancers, and cancer centres cannot possibly treat all surgical cases.

3. PATHWAY

Figure 1 illustrates the surgical care pathway. The surgical care pathway encompasses the pre-operative, operative (or intraoperative) and post-operative phases of care, which are together are referred to as perioperative care.

Figure 1: The Surgical Care Pathway



Pre-operative care begins with outpatient investigations to help determine a diagnosis. Investigations may include pathology, medical imaging, additional consultations and blood work. See the *Cancerpedia: Medical Imaging* and *Cancerpedia: Laboratory Medicine* and *Pathology* chapters for more information. When a patient's diagnosis is determined, a surgical treatment plan is developed and a surgical procedure is booked.

Once the procedure has been booked, the patient visits a pre-admission clinic. For more information about clinics, see *Cancerpedia: Outpatient/Ambulatory Care* chapter. During a pre-admission visit, the patient undergoes a standard, detailed evaluation, which may be conducted by a physician, nurse practitioner, advanced practice nurse or interprofessional/multidisciplinary team (e.g., nursing, anaesthesia, medicine, pharmacy, etc.). The patient also receives educational materials and information, including a clear outline of the individual's disease, the anatomy involved, the plan for surgical treatment, other available treatment options, the expected outcomes of surgery (i.e., both positive and potentially negative), and the expected outcomes of other approaches, including declining treatment. In addition, a full written account of the proposed procedure must be accompanied by a diagram of the operation, customized to the patient's individual problem. Ideally, a relative or friend should be involved in the discussion, so the concepts can be reiterated to the patient after the consultation is complete. Interpretation services should also be made available, as needed. See the *Cancerpedia: Patients* chapter for more information.

During this time, the patient may undergo additional tests requested by the surgeon (e.g., blood work, cardiograms, chest X-rays). Other tests or consultations that are needed to identify risks and ensure the patient is fit for surgery may be ordered at this time. Patients who are scheduled to have major cancer surgery may be seen by an anesthesiologist and other specialists, if needed. Generally, a pre-admission clinic visit should occur within two to four weeks of a scheduled surgery.

All surgical patients require a pre-operative assessment, especially to identify cardiac risk factors, so that necessary preventative measures can be put in place.[9] Pre-operative anaesthetic assessments help decrease the patient's anxiety and may lead to increased patient satisfaction.[10] Given that comorbidities are associated with poorer health outcomes, more complex clinical management and increased health costs, pre-operative assessments that identify and mitigate the impact of comorbidities have positive effects on outcomes and may reduce the cost of care.[11]

For elective cancer patients who are to be admitted on the day of their surgery, all pre-operative planning should take place in the pre-admission clinic. Other surgical patients wait and are prepared in the pre-operative care unit (POCU) prior to entering the operating room.

In the POCU, patients are positively identified and put on a hospital gown, the intended operation is confirmed, the operative site is prepared, the venous thromboembolism prophylaxis is administered, and required preoperative sedation and antibiotics are administered. The surgeon meets with the patient and family so that the incision can be marked, and arrangements are made for contact after the procedure.

Operative care includes the surgical procedure and takes place in the operating room or theatre. Patients may receive a local or general anaesthetic. If space is available and the type of anaesthesia permits (e.g., local conscious sedation, regional blocks), the anaesthetic may be administered in the POCU or in a separate, dedicated room outside of the operating room. Additional diagnostics (e.g., imaging, pathology) may be required during operative care.

Post-operative care includes recovery within hospital. This recovery can occur in a range of environments, depending on the patient's procedure and their clinical needs.

- The *post-anaesthetic care unit* (PACU) – also known as the recovery room or post-anaesthetic recovery room – is where the majority of cancer patients go immediately following surgery to recover from sedation or anaesthesia. The PACU is a critical care environment that provides full invasive monitoring and ventilation by appropriately trained anaesthesiologists and nurses.
- Surgical patients who have a life-threatening condition and require post-operative ventilation and intensive monitoring may be admitted to the *intensive care unit* (ICU) – also known as the critical care unit – either after their stay in the PACU or directly if they need immediate care.

- A *step-down unit* provides an intermediate level of care to patients who no longer need the highly-specialized services of an intensive care unit (e.g., mechanical ventilation), but are not ready for transfer to a regularly-staffed inpatient care unit.
- Patients who need to stay in the hospital after their surgery for any length of time and who are not in need of intensive care are admitted to an *inpatient care unit*.

C. RESOURCES

Resources include facilities and equipment, human resources and information management infrastructure required to provide a comprehensive cancer surgery service. The core resource elements required are standard; however, various factors may impact the level and configuration of the resources required by a specific cancer centre. For example, increased resources may be needed to support higher patient volumes or the use of highly-specialized surgical services, techniques and technologies. In addition, a cancer centre that is part of a larger healthcare facility may configure its resources in ways to support surgical services for a broader patient population. As is always the case for highly-complex diseases, flexibility for surge situations may be necessary to manage unexpected, emergency complications.

4. FACILITIES AND EQUIPMENT

Each stage in the surgical care pathway, as illustrated in Figure 1, must be fully understood when designing a facilities infrastructure. Surgical facilities design should consider the following:

- The location of, and links between, each service to support the effective, efficient and safe flow of surgical patients. In particular, infectious diseases must be managed and the risk of nosocomial infections must be reduced (e.g., through isolation rooms or areas, universal precautions).
- Minimization of the number and length of patient transfers from one service area to another, where possible.
- An assessment of necessary adjacencies, including consideration of the areas and departments that should be directly connected to one another, those that should be conveniently connected using restricted (i.e., non-public) corridors or elevators, and those that can be separated by a distance.
- Effective hand-offs as the patient passes through a number of segments of treatment during the surgical experience. Each hand-off must be careful, complete and documented to ensure best practices and patient safety. For more information, see the *Cancerpedia: Clinical Management* chapter.
- The need for waterless hand hygiene stations.

All members of the surgical care team – i.e., surgeons, nurses, anaesthesiologists, respiratory therapists and others – should be represented in designing the surgical infrastructure and selecting equipment. For example, staff should provide input on functional details, such as the best position for light standards on ceiling anchor points, the texture and colour of the operating room floor and the height of scrub sinks.

This section briefly describes the activities that occur along the surgical care pathway and the associated core facilities and equipment requirements. Decisions about facilities design and layout and equipment must also meet the standards and requirements set by the local, subnational and national regulatory bodies of the jurisdiction in which the cancer centre is located.

Pre-Operative Care

Booking

The cancer centre's booking office works with the offices of surgeons who wish to book planned surgical procedures. The booking office helps to identify required resources for each surgical case and to guide the scheduling of the surgery based on the patient's requirements for equipment or implants, the clinical priority (i.e., urgency of their condition), the anticipated need for an intensive care unit bed post-operatively and any special needs.

The booking office should use standardized procedures to schedule patients for the surgical day, to manage underused or released scheduled time, and to address instances when scheduled cases need to be cancelled.

In terms of facility infrastructure, an operating room scheduling and booking system is required to manage cases by clinical priority, and address urgent and emergency situations. The system should support seamless communication between the booking office and the operating room, and is ideally electronic. It should also be linked to the patient health record. See the *Information Management* section of this chapter for more information.

Pre-Admission Clinic

The pre-admission clinic should include waiting rooms, private consultation space and the capacity to transport patients for tests if they cannot be obtained in the clinic. Standard evaluations and education materials as well as patient-specific information are essential. Education materials may include information about the cancer centre, surgical procedures, how to prepare for surgery (e.g., smoking, medications, nutrition), what to expect before surgery, what to expect the day of surgery and recovery from surgery. Patients should receive the contact details of a person who can answer their questions before admission and surgery. Ideally, the patient should remain in one room and various medical personnel should come to the patient for their evaluations, thereby supporting the concept of patient-centred care. For more information about clinics, see *Cancerpedia: Outpatient/Ambulatory Care* chapter.

The pre-admission clinic also needs access to the patient health record so that pre-admission information can be added to the patient's pre-operative chart and made available prior to surgery. Ideally, this access is electronic. See the *Information Management* section of this chapter for more information.

Pre-Operative Care Unit

The design of the POCU must include physical space to support various purposes including: the patient and family's needs for privacy, confidentiality and security (e.g., changing clothes, storing belongings, having privacy while gowned and waiting for surgery or accessing washroom facilities); private patient-physician meetings; the administration of pre-operative sedation and antibiotics; and infection prevention and control, which may include isolation rooms. The number and type of isolation rooms required depends on the number of surgeries and scope of services performed at a cancer centre, and an assessment of the infection control risk. See the *Cancerpedia: Infection Prevention and Control* chapter for more information.

Operative Care

Operating Room

Generally, the design and construction of operating rooms is governed by standard requirements and guidelines set by regulatory bodies at the subnational and national levels; for example, the Canadian Standards Association health and safety codes and standards.[12] Operating room standards set out the infrastructure required for inpatient and outpatient procedures, and may also outline additional infrastructure to support a range of minor and major surgical procedures.

The design and construction of operating rooms must consider the following:

- *Room size*: The size of an operating room will vary, depending on how much anaesthetic space is required, the size of the equipment used, the size of the X-ray viewing system, and the need for additional equipment and staff for certain types of cancer surgery. Many cancer surgeries can be performed in a standard-sized operating room, which should be a minimum of 600 square feet and offer capacity for imaging, open surgery and minimally invasive procedures. Some specialized and complex surgeries, as well as those that require innovative equipment and techniques, may necessitate 900 to 1,000 square feet of space to accommodate additional equipment and staff. For example, some surgery may use intraoperative brachytherapy. Hybrid suites with sophisticated imaging equipment require a significantly greater space.
- *Flexibility*: Operating room design and space should be flexible, rather than customized to the type of technique that is being performed at a certain point in time. A flexible design supports the addition of surgical specialties and new surgical techniques (e.g., robotics, telesurgery, minimally invasive surgery, CT and MRI image-guided surgery) to the centre over time. If it is unclear how to configure flexible operating room space given rapid changes in surgical techniques, shelling in additional space that can be configured for future changes in surgery should be considered.

- *Consistent layout*: The design and set-up of all operating rooms in the cancer centre should be consistent, where possible (i.e., similar placement of equipment, machines, tables). A consistent layout removes the need for operating room staff to adjust to different room designs and layouts, resulting in more efficient and safer care. If the cancer centre performs a large proportion of day surgeries, the operating rooms used for these procedures may have a different layout than inpatient operating rooms.
- *Optimal use of space*: Making the best use of operating room space can include: mounting equipment on hydraulic booms hanging from ceilings, rather than placing it on the floor; installing a sufficient number of appropriate electrical connections in locations that avoid tripping hazards (e.g., no floor outlets); and equipping the operating room with only the essential equipment and instruments needed to perform the surgery. Wide, sterile corridors located between banks of operating rooms can be designed to hold additional equipment and instruments, keeping the operating rooms themselves as free as possible of additional items and clutter.
- *Information and communications*: Infrastructure is required to gather, communicate and document information in the operating room. This may include information technologies such as a picture archiving communication system (PACS) to transfer images, and electronic record keeping systems to document the steps of a surgical procedure. Infrastructure is also needed to take pictures of open and laparoscopic procedures (e.g., standard digital cameras; cameras that digitize analog images to be sent for consultation, education or presentations). Infrastructure to support communications in the operating room and between the operating room and other areas or professionals (e.g., other surgical specialists, radiologists, pathologists) includes video links, standard and wireless telephones, intranet connectivity, paging and locating systems, electronic call systems for emergency situations and teleconferencing capabilities.
- *Specific facility infrastructure requirements*: In addition to the design and construction considerations noted above, local, subnational and national regulatory bodies may stipulate facility requirements for operating rooms, such as:
    - Types of walls, ceilings, floors and lighting
    - Set-up of isolation areas and operating rooms to control infection
    - Capacity for separate traffic flow of sterile and soiled materials, including separate storage areas for supplies and equipment
    - Ventilation systems, including backup for outages and maintenance
    - Electrical outlets for normal and emergency power use, including emergency power backup
    - Appropriate voltage levels to support the full range of equipment in the operating room
    - Thermostat controls, to keep patients and operating rooms at an appropriate temperature
    - Patient sliders, to transfer patients from a bed or stretcher to the surgical table
    - Housekeeping services, to support infection prevention and control, and the efficient and effective turnover of patients in the operating room

External Facility Infrastructure to Support the Operating Room

Figure 2 illustrates the external facility infrastructure required to support the operating room and its surgical activities.

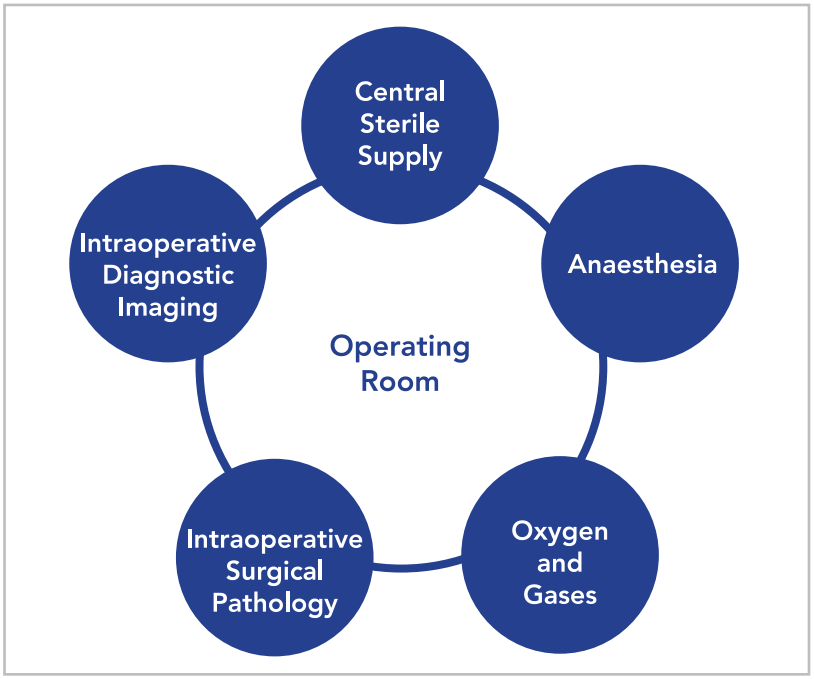


Figure 2: External Facility Infrastructure Required to Support the Operating Room

Central Sterile Supply

A central sterile supply department (CSSD) focuses on decontaminating, sterilizing and reprocessing all reusable instruments used at the cancer centre, in areas such as emergency departments, inpatient and outpatient care units and clinics, laboratories and operating rooms. The CSSD works closely with the infection prevention and control team and the cancer centre's clinical departments to ensure that current and changing standards of sterile practice are being used. See the *Cancerpedia: Infection Prevention and Control* chapter for more information. Other terms for the CSSD include central sterile processing, central processing, the central supply unit, and central supply and reprocessing.

Generally, the CSSD requires physical infrastructure to support four major areas of activity:[13]

- *Decontamination*: Reusable equipment, instruments and supplies are cleaned and decontaminated. The decision to reuse items should be based on scientific or internally-generated evidence that patient safety will not be compromised.
- *Assembly and packaging*: Clean items are received from the decontamination area, where they are assembled and prepared to be issued, stored or processed further (e.g., sterilized).
- *Sterile storage*: Items that have been assembled or sterilized are placed in a sterile storage area.
- *Distribution*: Instruments, sterile supplies and reusable equipment are distributed, case carts for surgical areas are prepared and delivered, orders are received and filled, and instruments and equipment are tracked.

Each of these areas of activity requires a facility infrastructure that enables a sterile and safe working environment. Generally, standards and requirements are set by subnational and national bodies. Examples include: appropriate construction materials (e.g., non-porous, seamless materials for floors and walls); appropriate workroom facilities (e.g., work counters, sinks, storage receptacles, waste receptacles); adequate heating and ventilation; systems to support selected cleaning methods (e.g., vacuum, compressed air); and appropriate sterilization and cleaning equipment and supplies (e.g., steam, ethylene oxide, hydrogen peroxide plasma). In particular, the decontamination area must ensure employee safety by providing appropriate personal protective equipment, including clothing, footwear, eye goggles and gloves.

The layout and space of each area of activity must minimize cross-traffic and cross-contamination, and support an effective workflow. There must be separate flows into and out of the CSSD for sterile and soiled items. For example, contaminated items should come through a separate corridor and undergo decontamination in a dedicated space before moving into the assembly and packaging area.

In addition to having a CSSD, a cancer centre may need sterilization equipment in a restricted-access area located outside the operating room to sterilize specialized instruments on-site or in emergency situations. Such an area can support more than one operating room, must meet sterilization equipment and process standards, and should be designed in consultation with the CSSD and infection prevention and control staff to ensure that the sterilization process is successful.

The CSSD should have an effective case cart system that facilitates the selection, preparation and distribution of the equipment and supplies needed for surgical cases. A case cart is a cart with all the supplies that are needed to perform a specific surgical procedure. Case carts should also be used to return soiled items to the CSSD. Trained experts should develop standardized packs, case carts and pick lists by procedure, rather than by individual physician. Centralizing the processing of materials for surgery has many advantages: inventory is consolidated and standardized, making it easier to monitor and more cost-effective and safe; surgical department space is used more efficiently, since standardized items are stored centrally; time is efficiently managed, since prepared case carts are unloaded and reloaded quickly; staff skills are used more effectively, since materials management staff manage supplies, whereas clinical staff care for patients; and infection prevention and control improves, since case carts are designed to protect sterile items and contain soiled ones.[14]

Anaesthesia

Patients may receive a local or general anaesthetic in the operating room or – if infrastructure space is available and the type of anaesthesia permits – in a dedicated room outside the operating room. All rooms need to meet facility and infection prevention and control standards.

In addition to the rooms where anaesthesia is administered, the cancer centre requires an anesthesia workroom, where anaesthesia equipment is cleaned, tested and stored. Generally, the room should include work counters, sinks, appropriate ventilation for the safe handling and use of noxious cleaning and sterilizing substances, and separate storage for clean and soiled equipment. If the workroom is large enough, it may also be used to store anaesthesia case carts and other anaesthesia equipment.

Oxygen and Gases

Medical gas piping and outlets must be connected to the operating room, along with scavenging systems for medical gases and laser procedures. Storage space is required for medical gases, including reserve gas cylinders.

Intraoperative Surgical Pathology

Surgical pathologists may examine specimens during surgery to help determine if and how a surgery should be modified. Various facility infrastructure options should be considered to support this work, such as: locating a dedicated frozen section testing area and point-of-care testing in the operating room; providing an automated system or dedicated personnel to transport specimens directly from the operating room to the laboratory for testing; and incorporating systems that allow for the delivery of high-resolution electronic images of the specimen to pathology. Communication systems, such as intercoms, may be needed to communicate the results of testing back to the operating room.

Intraoperative Diagnostic Imaging

Increasingly, real-time imaging is being used during highly specialized surgical procedures. In terms of facility infrastructure, CT and MRI (magnetic resonance imaging) equipment is usually connected to rails mounted on the floor or the ceiling, to enable scans to be taken during surgery. A ceiling-mounted scanner helps minimize floor clutter, improves infection prevention and control, and improves workflow. To maximize the use of costly scanning equipment, ceiling-mounted rails can run between more than one operating room, with a room between the surgical suites where scanners can be used to image additional patients between surgeries.[15]

Post-Operative Care

Post-Anaesthedic Care Unit

Although cancer centres perform the most complex, specialized cancer surgeries, they also perform less complex surgical procedures. In terms of facility infrastructure, the PACU may be a single unit or include level-1 and level-2 recovery units. PACU-1 should focus on patients who have received more complex regional and general anaesthesia, and who need more intensive monitoring and equipment. PACU-2 should focus on patients who have received local anaesthesia with sedation or who need to be observed after a procedure. Generally, PACU-2 serves as a pre-discharge unit for outpatients who have recovered from sedation and are expected to go home. Other terms for the PACU-2 include the step-down recovery unit, surgical day unit and medical day unit.

The size of the PACU is directly related to the number of operating rooms and the volume of surgical procedures at a cancer centre. Subnational and national regulatory bodies set out facility infrastructure standards and guidelines for the PACU. These include, but are not limited to: nursing and medication stations; clinical and patient sinks; waterless hand hygiene stations; digital image viewing capabilities; medical gas terminal units; storage space; and provisions for patient privacy. Isolation space for infectious patients is required, along with separate links and storage for sterile and soiled materials.

The PACU should be located in close proximity to operating rooms, and linked through doorways or corridors that have restricted access. Cancer centres that perform a high volume of day surgeries or short-stay procedures should consider a separate PACU for these patients.

Facility infrastructure can be maximized with flexible use of the PACU and pre-operative care areas. This may involve clustering these areas, if a sufficient number of surgeries are performed.

Intensive Care Unit

ICUs have sophisticated monitoring and resuscitation equipment, provide multiple specialized medications, and have highly-trained, multi-professional staff, including physicians, nurses, pharmacists and respiratory therapists.

In terms of facility infrastructure, ICUs must be large enough to house multiple pieces of equipment, and accommodate the care team, families and visitors, and students who are being trained. ICUs must also be designed so that all patients can be easily observed from staff workstations and quickly accessed in case of emergencies. Workstations should be large enough to accommodate administrative tasks. Additional facility requirements include: private office space; staff rooms for meetings and respite; family lounges and private spaces for confidential meetings with families; storage for equipment, supplies and medication; and medication dispensing areas. The ICU is a restricted area and needs appropriate security provisions.

Specific facility standards and requirements for the design and layout of the ICU are set by subnational and national regulatory bodies. These include requirements for heating and ventilation, lighting, acoustics, medical gases, electrical outlets, construction materials, communication technologies, room space and other provisions.

The layout and design of the ICU should be adaptable and flexible. Patient rooms should be large enough to perform a range of procedures, so that patient transfers are kept at a minimum. As well, rooms should be able to accommodate more than one patient if there is a surge in capacity. The rooms should also be organized into clusters, in case a negative pressure area is needed to contain infections.

Step-Down Unit

The layout and design of a step-down unit should accommodate appropriate equipment and services to meet the needs of patients. Step-down units can be stand-alone units or co-located with the ICU or an inpatient care unit.

Inpatient Care Units

Inpatient care units must meet facility infrastructure standards and requirements for design, layout, equipment and materials. Depending on the acuity of surgical patients in the cancer centre, inpatient care units may need to incorporate the equipment and capacity (e.g., larger rooms, mechanical and electrical supports) to perform procedures and tests at the bedside that go beyond regular, non-invasive monitoring. Inpatient care units must support the management of infectious diseases and reduce the risk of infections. A sufficient number of inpatient care rooms and spaces should serve as, or be available as, isolation units in the event of an infectious outbreak.

Specific standards and requirements for the design, layout, equipment and material of inpatient care units are set out by subnational and national regulatory bodies. These include, but are not limited to, requirements for: heating and ventilation; lighting; acoustics; medical gases; electrical outlets to support bedside technologies; construction materials; communication technologies; room size and functions; staff workspace; storage space, including space to store and dispense medications; waste management; public access; transport to and from the unit (e.g., food, supplies, equipment); and lifting devices. See the *Cancerpedia: Inpatient Care* chapter for more information.

5. HUMAN RESOURCES

Surgery engages an interprofessional/multidisciplinary team that includes surgeons, anaesthesia services, nursing, perioperative service providers, anatomic pathology, a variety of specialized medical services and program support staff. All members of the surgical team are expected to contribute their professional skills and expertise to a collaborative working environment. Generally, the broad functions fulfilled by team members are standard; however, job titles and who performs specific functions may vary by jurisdiction and scope of practice.

Surgical Expertise

Cancer surgery is performed by surgical oncologists (cancer surgeons) or other specialty surgeons. Cancer surgeons have special training and a primary and major focus of activity in cancer surgery. Other surgeons operate on a variety of conditions and may include elements of cancer care in their practices.

Cancer surgeons are trained in the technical aspects of cancer diagnosis and surgical treatment, are knowledgeable about other cancer treatments, and are expected to work as part of an interprofessional/multidisciplinary team. Increasingly, cancer surgeons are becoming more specialized and focusing their practice on particular disease or specific surgical technique.

The range of surgeons at a cancer centre includes the following:

- ***General surgeons***: General surgeons may work in a number of specialized areas, but they are increasingly specializing in one anatomic area or disease. Cancer centres may not have a full range of subspecialist surgeons on staff, but should have access to this expertise for consultation.
- ***Gynecologic surgeons***: Gynecologic oncologists perform minimally invasive techniques for gynecologic tumours, as well as multi-site abdominal surgery (including robotic surgery) for ovarian, cervical or uterine cancers.
- ***Neurosurgeons***: Most neurosurgeons perform cancer surgery, including surgery for brain tumours, skull-based specialized surgery, spine surgery and peripheral nerve surgery.
- ***Ophthalmologists***: Ophthalmologists diagnose and treat malignancies of the eye and orbital structures.
- ***Orthopedic surgeons***: The orthopedic cancer surgeon performs oncologic limb surgery with limb preservation techniques, and specialized pelvic surgery. These surgeons also provide bone biopsies for virtually any site of the body.
- ***Otolaryngology/head and neck surgeons***: Head and neck surgeons perform advanced surgical procedures for head and neck cancers.
- ***Plastic surgeons***: Plastic surgeons who work in cancer bring their specialized expertise to bear in comprehensive reconstructive surgery and microsurgery. Plastic surgeons may also manage primary cutaneous tumours.
- ***Thoracic surgeons***: General thoracic surgery has developed as a specialty separate from cardiac surgery mainly because of specialized interests in cancer. In addition to diagnostic and treatment procedures, thoracic surgeons make a significant contribution to the overall management of many palliative cases.
- ***Urology surgeons***: Urologic oncology has developed as a separate specialty, partly due to increased treatment options for prostate cancer. Urologic oncologists have expertise in prostate, kidney, bladder and testis cancers.
- ***Vascular surgeons***: Many cancer surgeons who perform major operations have experience with vascular techniques. In a cancer centre, it is common for patients to require the special expertise of a vascular surgeon.

The number of surgeons required from each specialty depends on the volume of patients and the type of cancers treated by a cancer centre.

The operating surgeon is the surgical team leader who supervises the operation. In major operations conducted at a cancer centre, the operating surgeon typically has at least one assistant, who is often a surgical resident.

Anaesthesia Services

Anaesthesia services are an integral part of the interprofessional/multidisciplinary cancer team. Depending on the complexity of the patient, the anaesthetic procedure, the type of anaesthetic, and the scope of practice of professionals in the jurisdiction, anesthetics may be administered by various healthcare providers.

- Physicians with specialty training in anaesthesia are known as ***anaesthesiologists*** in North America and as anaesthetists in the United Kingdom and Europe. In the United States, the term anesthetist refers to those who are not qualified physicians, but who provide anaesthetic (e.g., nurse-anesthetists).

- Physicians with short-term, intensive training in anaesthesia may administer anaesthesia in certain cases (e.g., general practitioner/family practice anesthesia).
- Various professionals have been used to expand the services provided by anesthesiologists, some of which include registered nurse anaesthetists, anaesthesia technicians, anaesthesia assistants, advanced care nurse practitioners, clinical nurse specialists and respiratory therapists. All of these professionals have additional training to work in surgical settings under the supervision of anaesthesiologists or physician-trained anaesthetists. The use of these professionals – and their training and scope of practice – varies by jurisdiction (for example, Merchant et al. 2013).[16]

Anaesthesia service staff play a number of roles throughout the surgical care pathway.

- In the ***pre-admission clinic***, patients who are having major cancer surgery, are undergoing general anaesthesia, or are complex due to other medical illnesses, their age or other factors may be assessed by anaesthesiologists.
- In the ***POCU***, pre-operative sedation and antibiotics may be administered by the anaesthesia service staff.
- In the ***operating room***, anaesthesia service staff provide the appropriate anaesthetic to support the surgical procedure and the needs of the patient. The range of anaesthetic procedures – which directly impact requirements for facility infrastructure and human resources – include: conscious sedation (i.e., the sedated patient remains conscious); unconscious or deep sedation (i.e., sedation puts the patient to sleep, but he or she can be easily aroused to a conscious state); neuroleptanalgesia (i.e., the patient's anxiety, sensitivity to pain and motor activity are reduced); general anaesthesia (i.e., the patient is unconscious and cannot be aroused); local anaesthesia (i.e., a body part is numbed); topical anaesthesia (i.e., local anesthesia is applied externally to the skin or mucous membranes); infiltration anesthesia (i.e., local anaesthetic is directly injected where it is needed); and regional anesthesia (i.e., also known as blocks, where a part of the body is made numb by injecting a local anaesthetic into the nerves going to that body part). In addition to administering the anaesthetic before and during surgery, anaesthesia service staff also monitor patients throughout the surgical procedure.
- In the ***PACU*** and ***ICU***, most patients who have undergone a major cancer operation receive anesthesia for acute pain from consultant anaesthesiologists.

One responsible anaesthesiologist is assigned to an operating room. Depending on the complexity of the surgery, the anaesthetic required and the anaesthetic procedure, an anaesthesia team may be assembled that includes additional anaesthesiologists or other anaesthesia professionals.

Nursing Expertise[17]

Nurses play a significant role and fulfil a broad range of functions throughout the surgical care pathway. The nursing scope of practice may vary by jurisdiction. Job titles and the specific responsibilities of each nursing role may also vary by organization.

In the ***pre-admission clinic***, nurses conduct a standard, detailed evaluation of patients who are scheduled for surgery, help prepare patients for surgery, and ensure that all pre-operative tests and consultations have been conducted. Generally, nurse practitioners, advanced practice nurses or an interprofessional/ multidisciplinary team that includes nurses conduct this function.

In the ***POCU***, nurses are part of the surgical team that prepares the patient for surgery and reviews the surgical checklist.

In the ***operating room***, nurses perform a number of key functions that include the following:

- Directing operating rooms or the perioperative program: This function ensures that policies, procedures and supporting practices are in place for the appropriate, efficient and effective functioning of operating rooms or the perioperative program. It also ensures that other departments appropriately link with operating rooms to support surgical activities. Job titles for this function include operating room supervisor, operating room director or perioperative program director. Typically, this function is performed by senior nurses with advanced nursing executive training and experience in the operating room and PACU.

- Managing operating rooms: This function ensures that all operating rooms run smoothly on a daily basis. It includes maintaining patient schedules and all surgical supplies and equipment required for scheduled surgical procedures. Job titles for this function include nurse manager, operating room manager or surgical services/operating room nurse manager. Typically, this function is performed by senior nurses with administrative and clinical operating room experience and expertise.
- Supervising individual operating room activities: This function ensures that each operating room runs efficiently and effectively. The person responsible for this function may assist other nursing staff with their clinical operating duties (e.g., enable breaks during long operations). Job titles for this function include team leader, clinical team leader or charge nurse.
- Supporting or participating in surgical procedures. A number of individuals fulfil this function including the following.

    - The circulator manages the nursing care of the patient and the environment during the operation. The circulator works in the non-sterile area of the operating room and conducts such tasks as maintaining vigilance for ongoing infection prevention and control, maintaining the sterile environment, loading digital images, bringing necessary instruments and equipment into the operating room, overseeing the flow of personnel into and within the operating room, recording information, and other tasks. Another job title for this function is circulating nurse.
    - The scrub nurse works in the sterile area of the operating room and passes the surgeon sterile instruments and other items that are needed in surgery. Other job titles for this function include instrument nurse or scrub practitioner.
    - The surgical first assistant works in the sterile area of the operating room and assists the surgeon by conducting technical functions to support a safe operation. Functions include, but are not limited to, helping position and prepare the patient, handling tissue, using instruments to provide exposure, providing hemostasis, suturing, and applying dressings and casts. Other job titles for this function include registered nurse first assistant or advanced scrub practitioner.

In the ***PACU*** nursing care is provided by highly-trained nurses who monitor the patient's condition (i.e., vital signs, pain, bleeding, nausea), care for surgical wounds and drainage catheters, and perform other duties.

In the ***ICU***, highly-trained nurses provide intensive monitoring and specialized care to patients who are usually ventilated. These nurses have expert critical care training.

In the ***step-down unit***, highly-trained nurses monitor and provide an intermediate level of care to patients who are not yet ready for transfer to a regularly staffed inpatient care unit.

Cancer centres may also have nurses who fulfil other perioperative functions, including:

- Patient care co-ordinators, who co-ordinates a patient's overall surgical care.
- Patient educators, who provide public and patient-specific information and education on cancer and cancer surgery. See the *Cancerpedia: Patients* chapter for more information.

For additional information on surgical nursing services in various jurisdictions, see:

- Asian Perioperative Nurses Association[18]
- Association of periOperative Registered Nurses (United States)[19]
- Australian College of Perioperative Nurses[20]
- European Operating Room Nurses Association [21]
- International Federation of Perioperative Nurses[22]
- Operating Room Nurses Association of Canada[23]
- Perioperative Nurses College of the New Zealand Nurses Organisation[24]
- SOBECC Nacional (Brazil)[25]
- The Association for Perioperative Practice (United Kingdom)[26]

Perioperative Service Providers

Some of the technical needs of the surgical team may be provided by specially-trained perioperative personnel, depending on the laws of a jurisdiction. Examples of perioperative service providers and their roles include the following:

- ***Scrub technologists*** conduct many functions are also performed by the scrub nurse (described above). Other terms for this function include instrument technologist, surgical technologist, or surgical or operating room technician.
- ***Surgical assistants*** are highly-skilled professionals who work under the surgeon's direction and conduct functions similar to that of the surgical first assistant (described above). Depending on the jurisdiction, the prerequisites and education requirements for surgical assistants may vary, along with the need for formal certification.[27-29] For example, the surgical assistant function may be fulfilled by other surgeons, surgical residents or healthcare providers with additional training (e.g., general practice physicians, registered nurses, and physician assistants). Other terms for this function include operations assistant or operating department practitioner.

Cancer centres must decide which staff to assign to various services and functions, given the laws of their jurisdiction, the scope of practice of each profession, and the complexity of the patient population served.

Program Support Staff

Program support staff include other professional and clinical staff, and program environmental support staff.

Professional and clinical staff provide additional patient care-related services to support successful surgery; for example, they help prepare the patient or the surgical environment for surgery, and work with the surgical team to support clinical or technical needs. They include, but are not limited to, clinical pharmacists, perioperative respiratory therapists and biomedical engineers. Additional professional and clinical staff may be needed for specialized surgeries (e.g., biomedical engineers to oversee the use of specialized equipment in the operating room).

Program environmental support staff assist with the effective flow of both patients and resources to and from the operating room. For example, operating room attendants transport patients, help set up and prepare the operating room, deliver equipment and supplies to the operating room, transport specimens, assist patients and the team during the set up of specialty equipment, and restock general supplies, along with other important tasks. The use of operating room attendants to perform support or technical tasks frees up the time of professional staff to perform their specialized duties. Other terms for this function include surgical orderly or surgical aide.

Human Resource Requirements

Although the standard surgical team is made up of surgeons, anaesthesiologists, nursing staff and technical staff, the actual makeup of each team varies depending on the complexity of the surgery, the procedures being performed and the type of anaesthesia being administered.

The size of the surgical team usually increases with the complexity of the surgery. The composition of the surgical team, the stability or turnover of team members, communication amongst team members and the complexity of the surgery all have an impact on operating room efficiency.[30,31]

Table 1 presents an overview of surgical service human resource requirements. In all cases, the volume of human resources required depends on the number of patients requiring surgical care.

Table 1: Surgical Service Human Resource Requirements

	Area	Goal	Estimated Human Resources Requirements[17,23,32]
Pre-Operative	Pre-admission clinic	Prepare patients for surgery	• Nurse practitioner, advanced practice nurse or interprofessional/multidisciplinary team (e.g., nursing, anaesthesia, medicine, pharmacy, etc.). • Patients having major cancer surgery plus an inpatient stay may be seen by an anesthesiologist and other specialists, as required.
	Pre-operative care unit	Prepare patients to go into the operating room	• Most responsible surgeon from the surgical team. • Most responsible anaesthesiologist from the surgical team. • Pre-operative nursing team.
Operative	Operating room	Perform surgery	• Surgeons: 1 or more depending on the surgery. • Anaesthesiologists: 1 most responsible; additional anaesthesia support, as required. • Nursing: 1 circulating registered nurse (RN); at least 1 perioperative RN; at least 1 scrub nurse; at least 1 surgical first assistant. Note: perioperative services providers may perform scrub nurse and surgical first assistant functions. • Program support staff: clinical pharmacists, perioperative respiratory therapists and biomedical engineers.
Post-Operative	Post-anaesthetic care unit	Provide immediate post-operative care in a critical care environment that provides full invasive monitoring and ventilation.	• Attending anaesthesiologist (usually with patient until extubated and stable). • Surgeon for consultation. • Nursing to patient ratio: - 1 to 1 when patient emerges from anaesthesia. - 1 to 2 when patient conscious, stable and uncomplicated. - Between 1 to 3 and 1 to 6 when patient is conscious, stable, uncomplicated and ready for discharge. • Respiratory therapist to ventilated patient ratio: between 1 to 4 and 1 to 7, depending on patient acuity and type of ventilation (i.e., invasive, non-invasive, non-ventilated, intubated).
	Intensive care unit	Provide intensive monitoring and care to surgical patients with life-threatening conditions.	• Multi-professional staff, including physicians, nurses, pharmacists and respiratory therapists with ICU specialty training. • Nursing to patient ratio: 1 to 1 or 1 to 2, depending on patient acuity. • Respiratory therapist to ventilated patient ratio: between 1 to 4 and 1 to 7, depending on patient acuity and type of ventilation (i.e., invasive, non-invasive, non-ventilated, intubated). • Access to clinical pharmacist. • Access to physical therapy, dietetics, spiritual services.
	Step-down unit	Provide intermediate care to patients who do not need the ICU, but are not ready for the inpatient care unit.	• Nursing to patient ratio: 1 to 2 or 1 to 3, depending on patient acuity. • Respiratory therapist: 1 per unit day. • Access to clinical pharmacist. • Access to physical therapy, dietetics and spiritual services.
Perioperative Management		Direct operating rooms/perioperative program.	• Experienced senior nurse with management experience and expertise.
		Manage operating rooms.	• Experienced senior nurse with administrative experience and expertise.
		Supervise individual operating room function.	• Experienced nurse (may assist with clinical operating duties).
Other		Co-ordinate patient's overall surgical care.	• Nurse: one or more depending on the number of patients.
		Educate surgical patients.	• Nurse: one or more depending on the number of patients.
		Support surgical patient and resource flow.	• Program environment support staff (e.g., operating room attendants, orderlies).

6. INFORMATION MANAGEMENT

The cancer centre needs a corporate-wide information management (IM) infrastructure that provides an overarching umbrella for the surgery-specific IM infrastructure. Ideally, the corporate-wide and function-specific IM infrastructure are electronic and fully integrated.

Surgery-specific IM infrastructure includes two main information systems, as illustrated in Figure 3.

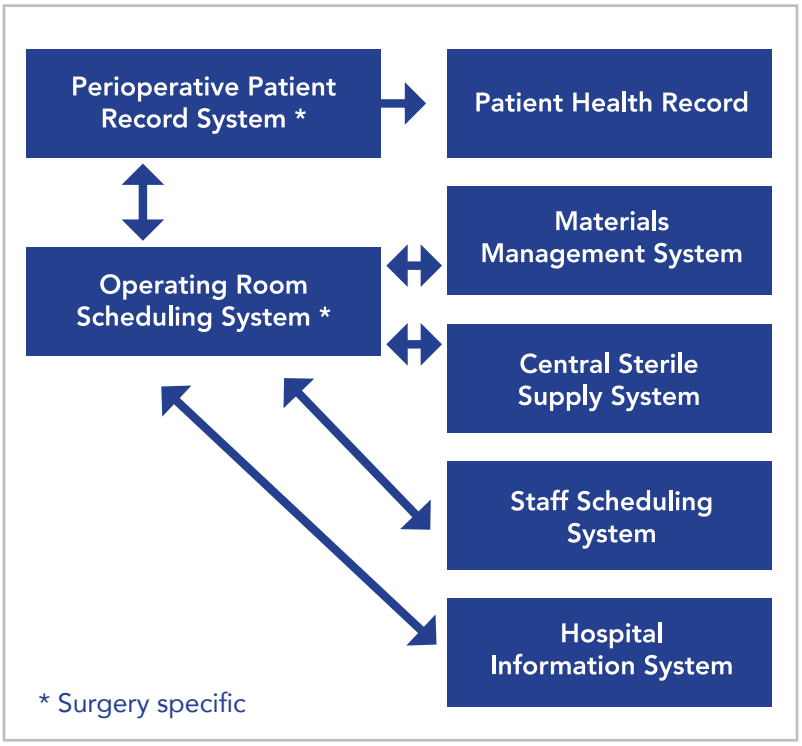
Perioperative Patient Record System

The perioperative patient record system includes patient-specific information from a number of sources.

- The offices of surgeons who wish to book planned surgical procedures for their patients provide information about the type of surgery, the clinical priority of the patient and special patient needs.
- The pre-admission clinic provides the results of each patient's pre-surgical evaluation, diagnostic test results, and information on routine and additional consultations. Cancer centres may wish to have a surgical pre-assessment scheduling system to ensure that all tests and consultations are completed before the date of surgery.
- The emergency department and other areas of the cancer centre may provide patient information in the event of unplanned emergency surgical cases.
- One or more members of the surgical team provide intraoperative and post-operative information about day of surgery preparation, the surgical procedure and surgical recovery.

The perioperative patient record becomes part of the hospital patient health record, which is especially important for the follow-up care of surgical patients.

Figure 3: IM Infrastructure for Surgery



Operating Room Scheduling System

The operating room scheduling system is directly linked to the perioperative patient record system, which provides valuable patient information that informs the booking of the surgical case and identifies the surgical and post-surgical resources the patient requires (e.g., operating room, human resources, supplies, equipment, post-operative beds).

The operating room scheduling system draws upon and balances multiple sources of information, including the following systems.

- The ***materials management system*** maintains and manages an inventory of equipment and supplies required to support surgery.
- The ***central sterile supply system*** tracks and receives orders, and distributes new and reusable equipment and surgical case carts containing instruments and sterile supplies.
- The ***staff scheduling system*** provides information on staff availability for surgery.
- The ***hospital information system*** includes the patient chart and identifies the patient's anticipated post-surgical care needs, such as ICU and inpatient care unit beds.

As Figure 3 illustrates, there is a two-way information flow between the operating room scheduling system and other systems. Successfully scheduling surgery is only possible if sufficient materials management, central sterile supply, staff and hospital resources are available. It is important to note that Figure 3

represents the standard, ideal state. As operating room activities are often revised or altered, systems must also be in place to manage unexpected cases or situations, such as complications requiring urgent surgery or procedures that run far over the expected operative time.

In addition to documenting a patient's clinical needs and scheduling surgery, the information in the perioperative patient record and operating room scheduling systems should be used to track and improve performance. See the *Cancerpedia: Quality* chapter for more information.

D. MANAGEMENT

7. LEADERSHIP

The surgical leadership team should reflect both clinical and administrative expertise. Although the structure of teams can vary by cancer centre, generally leadership should include representatives from surgery, anaesthesiology, nursing, other clinical groups and administration, such as a surgeon-in-chief, an anaesthetist-in-chief, a senior nurse executive or director of nursing, a medical director of the operating rooms, the directors of surgical oncology and the medical and surgical ICUs, and the operations director of surgical services. The leadership team is accountable for planning, managing and improving surgical performance, and is responsible for the smooth functioning of an effective and efficient surgical service. Suggested responsibilities of team leaders include, but are not limited to:[1]

- Developing an objective process to monitor performance, allocate resources and set perioperative management goals
- Identifying and monitoring the implementation of safe practice standards
- Monitoring quality, patient safety outcomes and perioperative performance
- Tracking the use of resources and implementing tactics to improve effective and efficient resource use
- Identifying issues at the individual provider, service and system levels
- Initiating and overseeing continuous quality improvement initiatives, and evaluating their impact

Each leader is responsibility for the clinical, academic and administrative performance of their staff, as appropriate, and is supported by a variety of support staff and services. For more information about essential support services for perioperative care, see the *Cancerpedia: Physical Facilities and Support Services* chapter.

In addition to the leadership team, cancer centres should consider the following committees.

The ***Surgical Executive Committee***:

- Oversees surgical operational activities in the cancer centre.
- Responds appropriately to changes in corporate strategies or mandates as they relate to surgical services.
- Identifies and develop leaders in surgical administration.

Committee members should include the surgeon-in-chief, the anaesthetist-in-chief, the director of nursing, the medical director of the operating rooms, the directors of surgical oncology and the medical and surgical ICUs, and others, as appropriate.

The ***Perioperative Committee***:

- Monitors activity in the operating rooms.
- Develops quality initiatives in the operating rooms.
- Develops and implements strategies in the operating rooms that enable the perioperative service to achieve its goals and objectives (e.g., improved communication in the surgical area, more efficient and effective use of resources).

Committee members should include representatives from surgical oncology, anaesthesia, nursing management, medical engineering, inventory management, CSSD, and others, as appropriate.

The ***Surgical Quality of Care Committee***:

- Monitors critical incident processes and events, and identifies and implements improvement tactics to address issues.

- Provides a forum to discuss issues about risk avoidance and patient safety, and fosters a "just culture" in which concerns about patient safety are discussed and addressed immediately with management.
- Communicates the outcomes of these discussions to all healthcare providers in the cancer centre for their information and implementation.

Committee members should include representatives from surgical oncology, anaesthesia, nursing management and the ICU, the operations director of surgical services, and others, as appropriate.

8. OPERATING STANDARDS AND GUIDELINES

Cancer centres must meet accreditation operating standards and guidelines set by various organizations.[33] Many countries have health service accreditation programs, whereas others adopt or adapt the programs of other countries. Accreditation standards and guidelines for hospitals and surgical services set out operational requirements to support a safe and effective service.

Services

Accreditation standards and guidelines for surgical services typically include requirements for the following:

- ***Admission***: Patients are evaluated and prioritized by the urgency of their condition; appropriate patient information is collected; patients and families receive necessary information and education; patient and family rights are respected; etc.
- ***Assessment and care planning***: Patients have a pre-operative assessment; an interprofessional/ multidisciplinary care plan is developed; timely access to diagnostic tests is consistent with clinical practice guidelines; patients and families are engaged in care planning; etc.
- ***Delivery of surgical care***: The surgical team is appropriate; clinical staff have clear roles and responsibilities; care is evidence-based and informed by clinical best practice guidelines; care is documented; etc.
- ***Delivery of post-surgical care***: Care is reviewed, documented, discussed with the patient and family, and understood by all, including the care team.
- ***Discharge, transfer and follow-up of the patient***: The discharge and follow-up process is developed and implemented.

Physical Facilities and Equipment

Accreditation standards and guidelines for surgical physical facilities and equipment typically include requirements to:

- Meet all planning, design and construction requirements set by regulatory bodies (i.e., subnational, national and international).
- Have a physical layout that ensures good patient management, workflow, efficiencies, and infection prevention and control.
- Ensure that all necessary surgical equipment and supplies are available and in good condition.
- Ensure that all physical facilities and medical equipment enable patients to be cared for safely.

Human Resources

Accreditation standards and guidelines for surgical human resources require the members of the surgical team to be fully qualified, licensed and able to meet the responsibilities expected of them. Beyond that, accreditation standards and guidelines may be general or specific, depending on the accreditation body. A general approach tends to identify broad human resource requirements to support a centre's surgical services. A more specific approach may identify the competencies required of each profession working in cancer surgery, as well as the staff number and mix in the operating room.

Quality and Patient Safety

Accreditation standards and guidelines for quality and patient safety tend to focus on requirements to have:

- A quality improvement plan for the perioperative service.
- Ongoing staff education on quality and safety.

- A performance improvement system that includes collecting and monitoring indicators and efforts to improve performance.
- Safe practices, such as use of the World Health Organization's *Surgical Safety Checklist*[37]
- Protocols for ongoing safety, such as infection prevention and control, universal precautions, medical management, handling of hazardous waste and substances, etc.

Examples of accrediting bodies that offer surgical standards and guidelines include, but are not limited to:

- Accreditation Canada, an independent, not-for-profit organization that accredits health organizations across the country.[34] Accreditation Canada also operates the Health Standards Organization, which is international.[38]
- The Australian Council on Healthcare Standards (ACHS), an authorized accreditation agency with the Australian Commission on Safety and Quality in Health Care.[36] ACHS accredits healthcare organizations to the National Safety and Quality Health Service Standards. ACHS also runs ACHS International.
- The Care Quality Commission, which is responsible for hospital accreditation and standards in the United Kingdom.[39]
- The Joint Commission, an independent, not-for-profit organization in the United States that accredits and certifies healthcare organizations and programs across the country.[40] The Joint Commission also runs Joint Commission International.
- The National Accreditation Board for Hospitals & Healthcare Providers (NABH), a constituent board of the Quality Council of India, set up to establish and operate accreditation programs for healthcare organizations.[35] The NABH also runs NABH International.

For additional healthcare accreditation bodies, see the International Society for Quality in Health Care, which accredits accrediting bodies.[41]

It is important that the above standards and guidelines are in place and accepted by every member of the healthcare team. Importantly, all healthcare team members must participate in regular conferences, meetings, case reviews and other quality measures so that the concepts of quality improvement and patient safety are universal commitments. For more information, see the *Cancerpedia: Clinical Management* chapter.

9. POLICIES, PROCESSES AND PROCEDURES

Policies, processes and procedures reflect different and interconnected levels of activity.

- Policies are the standards and guidelines of the cancer centre that govern how it operates. The centre's operating policies should reflect accreditation operating standards and guidelines. Policies drive processes and procedures.
- Processes set out what the cancer centre will do to achieve its policies. Processes usually identify who is responsible for performing a process (e.g., department), and the associated major functions or tasks that will be performed. Processes are high-level actions that drive specific procedures.
- Procedures identify the specific steps that will be taken to perform a task, how they will be done, by whom and when.

Cancer centres need to establish policies, processes and procedures, and make these readily available to all perioperative staff, along with training, as required. Examples of areas in which surgical policies, processes and procedures should be developed include the following:

- ***Case booking and scheduling***: booking of operative cases (elective); booking of emergency cases; cancellation of scheduled cases; management of underused or released scheduled time; scheduling of operating room blocks; same day admission; etc.
- ***Patient clinical requirements***: blood and blood products; blood, gas and metabolic testing; refusal of blood products; pre-operative skin preparation; pathology specimens; transport of patient to and from operating room; acute transfusion reactions; cardiac arrest; latex allergy; malignant hypothermia care after death; organ retrieval; etc.
- ***Patient identification requirements***: identification bands/allergy bands; MedicAlert© bracelets; consent to treatment; consent for photography; unsigned or wrong consent; positive patient identification; translation and interpretation services; patient personal property and valuables; etc.
- ***Safety***: surgical scrub; body substance precautions; infections and communicable diseases; infection

prevention and control; isolated patients; radiation from X-rays; fire procedures; violence and harassment; safety codes; etc.
- ***Adverse events***: correct patient, procedure and site; surgical counts; disclosure of adverse events; incident reporting; pre-operative checking of patients; checklist process; etc.
- ***Supplies***: equipment and supply availability; drug distribution; etc.
- ***Infrastructure***: electrical failure; light or fan system failure; etc.
- ***Personnel***: responsibilities of operating room personnel; logistics nursing; presence of a surgeon during an operation; surgeon of the month; etc.
- ***Students/others***: nursing student practice; healthcare observer privileges in the operating room; non-healthcare observers in the operating room; traffic control and observers in the operating room; etc.

10. MANAGEMENT OF PATIENT FLOW

Cancer centres must manage the smooth flow of patients across the surgical care pathway, as illustrated in Figure 1. As the surgical patient moves from one service to the next, centres must ensure that referral processes are in place and that formal handoffs occur between most responsible staff at each point of transition.

Table 2 outlines the management of patient flow at each stage of the surgical care pathway.

Table 2: The Management of Patient Flow by Stage of the Surgical Care Pathway

Stage		Management of Patient Flow
Pre-Operative		
1.	Referral for surgical oncology consultation	• Primary care provider or specialist requests surgical oncology consultation. • Request for consultation assessed by surgical oncologist's office using a standard process. • Consulting surgical oncologist reviews referral material and orders additional investigations, as required.
2.	Consultation with surgical oncologist (most responsible provider/ physician or MRP)	Surgical oncologist: • Reviews available test and specimen results. • Co-ordinates with other oncologists, as required (i.e., radiation, medical). • Arranges additional investigations, as required (e.g., blood work, radiology). • Sees patient and determines: i) surgical plan; ii) need for additional staging and investigations; iii) need for additional specialist opinions. • Outlines for the patient: the surgical plan; instructions for next steps; numbers to call for further questions; and patient education resources, such as pamphlets and websites.
3.	Booking office	• Surgeons connect with booking office to book surgery. • Booking office schedules patients for the surgical day. • Booking office connects with pre-admission clinic to provide patient information, along with surgeon's request for tests and other consultations.
4.	Pre-admission clinic	• Pre-admission clinic receives information from the booking office. • Pre-admission evaluations communicated to the surgeon and the booking office and added to the patient's pre-operative chart, to be made available prior to surgery.
5.	Pre-operative care unit	• Patient prepared for surgery (i.e., same-day admission), including incision marking and a visit from responsible surgeon. • Surgeon meets with patient and family/friends.
Operative		
6.	Operating room	Prior to the surgical procedure: • Staff cleans and decontaminates the operating room. • Central sterile supply provides sterile instruments, supplies and equipment (i.e., case carts) appropriate for the surgical procedure.
		• The patient is transported to the operating room. • The anaesthesiologist administers the anaesthetic (if not completed already) and antibiotics. • The Surgical Safety Checklist is performed by the surgical team, including all three components: the briefing, the timeout procedure and the debriefing at the close of the procedure. • The nurse or surgeon communicates with family during the procedure. • Intraoperative surgical pathology and diagnostic imaging are provided, as required, with the pathologist and radiologist communicating his or her diagnosis to the surgeon. • Documentation of the surgery is added to the patient health record. • The patient is transported to the PACU or ICU.

Stage		Management of Patient Flow
Post-Operative		
7.	Post-anaesthetic care unit	• The patient is transported from the operating room to recover from sedation or anaesthesia. • The surgeon visits or calls family members to explain the procedure and outcomes. • Nursing, pharmacy, physiotherapy and/or discharge staff provide discharge and post-discharge instructions and information. • Arrangements are made for discharge home with supports, or transfer to another facility, as required.
8.	Intensive care unit	• Patients with life-threatening conditions are admitted to the ICU directly from the operating room, or after a stay in the PACU. • The surgeon visits family members to explain the procedure and outcomes, if not completed already.
9.	Step-down unit	• Staff provide an intermediate level of care to the patient. • Nursing, pharmacy, physiotherapy and/or discharge staff provide discharge and post-discharge instructions and information (e.g., diet, medication, complications, contact numbers, etc.). • Arrangements are made for discharge home with supports, or transfer to another facility, as required.
10.	Step-down unit	• Staff provide an intermediate level of care to the patient. • Nursing, pharmacy, physiotherapy and/or discharge staff provide discharge and post-discharge instructions and information (e.g., diet, medication, complications, contact numbers, etc.). • Arrangements are made for discharge home with supports, or transfer to another facility, as required.
11.	Post-discharge	• A nurse practitioner or nurse makes a follow-up phone call to the patient to monitor progress at home.

11. DATA-INFORMED MANAGEMENT DECISIONS

Cancer centres must collect and analyze standard perioperative information to ensure that patients receive services consistent with the policies and procedures of the organization, perioperative resources are being used effectively and efficiently, and perioperative practices are safe.

Documentation is required throughout the surgical care pathway, as illustrated in Figure 1. Given that the amount of data collected can be overwhelming, management should develop a minimum data set, with clearly defined key indicators to monitor activities and processes and improve performance. Indicators should be analyzed to support data-informed management decisions, and management tactics should be implemented to mitigate risks and make improvements. Improvements can be assessed in various ways; for example, the centre can focus on internal performance improvements, compare its performance in relation to external standards or compare its performance in relation to external peer group benchmarks.

Table 3 presents a suite of perioperative management indicators that may be considered for a cancer centre's minimum data set. Additional indicators depend on local circumstances. Table 3 also presents potential management analyses targeted at improving performance.

Table 3: Examples of Perioperative Indicators and Management Analysis

Area	Indicators	Management Analysis
Patient	• Number of surgical patients. • Patient demographics. • Complexity profiles of patient mix.	• Profile of patients by age, gender, location of residence and analysis of variation over time.
Pre-Operative	• Number of scheduled surgical cases undergoing the pre-admission process. • Number of patients with surgery cancelled because they are "not ready." • Number of patients and families who are educated about the procedure and care. • Number of same-day admissions by surgery type.	• Rate of pre-admission screening compared to target, and improvement tactics. • Analysis of reasons why patients "not ready" and surgery cancelled, and improvement tactics. • Rate of education compared to target, and improvement tactics. • Rate of same day admissions compared to target, and improvement tactics.
Operative: Surgical Volumes	• Number of inpatient and outpatient surgeries by type of surgery. • Number of urgent cases in the average surgical workload.	• Volume changes tracking. • Analysis of impact of urgent cases on surgical schedule and improvement tactics.
Operative: Process Flow	• Time patient enters and exits operating room. • Time anaesthesiologist enters operating room. • Time surgeon enters operating room. • Start time of anaesthetic and time patient ready. • Start time of operation and finish time. • Time of antibiotic administration and dose. • Hours scheduled for surgery and hours actually used, by service and surgeon.	• Number of surgical delays and reasons why: i.e., patient action (e.g., late arrival); provider action (e.g., late arrival); clinical causes; non-clinical causes (e.g., equipment failure, insufficient or inappropriate instrumentation and supplies), plus causal analysis and improvement tactics. • Analysis of variation in scheduled and actual hours for surgery, and tactics to address variations.
Operative: Safety Best Practices	• Compliance with Surgical Safety Checklist. • Compliance with surgical preparation and positioning. • Complete, detailed anaesthetic report provided by anaesthesia. • Complete, detailed operative report provided by surgeon, preferably in synoptic form and including diagrams, where indicated. • Appropriate counts of needles, sponges, instruments, and other supplies. • Adverse event reporting.	• Rate of compliance compared to target (i.e., with checklist, surgical preparation and positioning, complete and detailed reports), and improvement tactics. • Analysis of variation in counts of needles, sponges, instruments and other supplies, and improvement tactics. • Rate of adverse events and near-misses, and mitigation tactics.
Operative: Cancelled Surgery / Operating Room Closures	• Number of operations cancelled on the day of surgery and within the past 24 to 48 hours, and reasons why. • Unplanned operating room closures and reasons why. • Operative incidents (e.g., related to the specific surgical case, risk-related events, behavioral issues that must be noted)	• Number of cancellations and reasons why: i.e., cancelled by patient, by hospital for clinical reasons, by hospital for non-clinical reasons (e.g., equipment failure, insufficient instrumentation and supplies; no ICU beds, etc.), plus causal analysis and improvement tactics. • Number of unplanned operating room closures and reasons why: i.e., no scheduled cases, lack of anaesthesia, lack of staff, etc., plus causal analysis and improvement tactics.
Operative: Use of Resources	• Number of instruments and supplies used in the operating room. • Number of surgeries conducted on days that are less than fully booked.	• Tracking of volume changes and costs, and opportunities for improved efficiency. • Development of improvement methodology to allocate operating room resources that considers patient needs, the urgency of the patient's condition, the strategic priorities of the organization and retaining physicians with sufficient operating time.

E. QUALITY

Quality performance in cancer surgery is critical, given that the vast majority of people with cancer will have a surgical procedure to support diagnosis, treatment, long-term survival or the management of cancer complications.[2,3] In addition, operating room suites are among the highest cost areas in most hospitals and surgery-related expenditures account for a significant proportion of a cancer centre's budget.[42]

There are multiple opportunities for quality to be compromised in surgical care:

- Pre-operative, operative and post-operative care may not be managed effectively, efficiently and optimally, resulting in wasted resources and potentially longer wait times for cancer surgery.[43,44]
- Long surgical wait times may negatively impact patient outcomes.[45,46]
- Surgical procedures may not meet quality standards, which may impact patient outcomes.[47,48] Especially in the area of complex, high-risk surgery, specific operations must be designated to centres that have the expertise and functional abilities to carry out those complex procedures. The distribution of these cases to various institutions may be administered by local authorities.
- Preventable adverse events that occur before, during or after a surgical procedure may threaten or harm patients' health, well-being and recovery.[49,50] Avoidable surgical complications account for a large proportion of preventable medical injuries and deaths globally. It is estimated that adverse events affect three to 16 per cent of all hospitalized patients, that more than half of these events are preventable and that at least half of these events occur during surgical care.[51] Preventable adverse events can also be costly to the system.[44,52]

There has been an increasing focus internationally, nationally and locally on improving the quality and safety of all surgical care. For example, over 300 organizations worldwide have endorsed the World Health Organization's Safe Surgery Saves Lives campaign and over 3,000 hospitals and healthcare facilities are using the *Surgical Safety Checklist*.[37]

The following section describes strategies and tools for preventing surgical errors and improving the quality of perioperative care.

12. STANDARDS, GUIDELINES AND BEST PRACTICES

Many surgical standards, guidelines and best practices are common to surgery and perioperative care for all patients. Cancer-specific guidelines do exist for the clinical management of cancer patients.

Standards, guidelines and best practices used by a cancer centre may originate from different sources, such as international, national and subnational organizations and bodies. Although cancer centres may develop local best practices, these should align with the national and subnational standards and guidelines of the jurisdiction in which the cancer centre is located.

Clinical Management

Clinical practice guidelines for cancer surgery are based on evidence or expert consensus, and are generally developed or recommended by larger health bodies. A number of organizations make available a wide range of cancer-related standards and guidelines, including those for surgical care. See the *Cancerpedia: Clinical Management* for more information about evidence and consensus-based clinical guidelines.

Professional Human Resources

All healthcare professional groups develop professional care standards and recommended practices for their members. Examples of professional bodies that develop perioperative human resource practices include the following:

Surgery

- International Society of Surgery[53]
- Canadian Society of Surgical Oncology[54]
- European Society of Surgical Oncology[55]
- Society of Surgical Oncology[56]

Nursing

- Asian Perioperative Nurses Association[18]
- Association of periOperative Registered Nurses (United States)[19]
- Australian College of Operating Room Nurses[20]
- European Operating Room Nurses Association[21]
- International Federation of Perioperative Nurses[22]
- Operating Room Nurses Association of Canada[23]
- Perioperative Nurses College of the New Zealand Nurses Organisation[24]
- SOBECC Nacional[25]
- The Association for Perioperative Practice (United Kingdom)[26]

Perioperative Practices

Cancer centres must implement quality perioperative practices that inform patient care in the following areas:

Up to and Including the Decision to Proceed with Surgery

Multidisciplinary Cancer Conference

The majority of cancer patients require a number of different clinical services from a range of healthcare providers working together in an interprofessional/multidisciplinary team. The multidisciplinary cancer conference (MCC) – also known as multidisciplinary care teams, multidisciplinary clinics and multidisciplinary meetings – is a quality practice that guides complex, evidence-based, shared decisions about treatment. See the *Cancerpedia: Clinical Management* chapter for more information.

Priority Rating System

Cancer centres should adopt a priority rating system to help guide decisions about timely access to cancer surgery based on clinical need. The system should:

- Define what is meant by surgical wait (e.g., date of decision to have surgery to the date when the surgery is performed)
- Establish standard priority levels (e.g., immediate to least urgent), develop standard clinical assessment criteria for each priority and identify recommended wait time targets for each priority.
- Carefully assess an organization's ability to manage specific, complex cases (e.g., esophageal or pancreatic cancer surgery in relation to other organizations, and enable the appropriate distribution of cases between institutions. The volume/outcome relationship as it relates to patient safety and clinical outcomes must be respected.

The priority of a cancer surgery patient may be influenced by a number of factors, including the type of cancer, the complexity of the patient and the extent to which the cancer has spread. Cancer centres may need to use surgical priority rating systems that have been developed at a national or subnational level. For example, the province of Ontario, Canada requires all surgeons to use a standard cancer surgery priority rating system, as described in Table 4.

Table 4: Cancer Surgery Priority Rating System, Ontario, Canada[57]

Priority	Definition	Time Period
1	Patients require immediate emergency surgery	24 hours
2	Patients are diagnosed with highly aggressive malignancies	14 days
3	Patients have known or suspected invasive cancer that does not meet the criteria of priority 2 or priority 4	28 days
4	Patients are diagnosed with indolent (slow-growing) malignancies	84 days

Throughout the Surgical Care Pathway

Key quality practices are required throughout the surgical care pathway, during pre-operative care, operative care and post-operative care and to facilitate flow within and across these stages of care.

Pre-operative Care Quality Practices

In the pre-operative care phase, cancer centres must ensure that quality practices occur in the booking office, pre-admission clinic and POCU. In addition, providing patient information and education is a key quality practice in the pre-operative phase. Patients require comprehensive information that is both generic and specific.

Generic information includes, but is not limited to, an overview of the cancer centre and the surgical care pathway, the surgical experience (i.e., how to prepare and what to expect), managing pain, and general post-operative planning and care.

Patient-specific information includes, but is not limited to, details on the patient's disease, the expected outcomes of surgery, requirements for pain control, how to address complications, details of after care and contact information.

In addition to providing this information, there should be ongoing dialogue with the patient and his or her caregivers to support the patient's needs and concerns.

See the *Cancerpedia: Patients* chapter for more information.

Operative Care Quality Practices

Cancer centres must establish operating room *protocols* to ensure quality and safety. Numerous international and national bodies have developed extensive guidelines and recommendations for safety protocols in such areas as infection prevention and control, universal precautions, and handling of hazardous biomedical waste and substances, including the following:

- The World Health Organization's Infection Control Standard Precautions in Health Care[58]
- The Australian Commission on Safety and Quality in Health Care's National Infection Control Guidelines[59]
- The Centers for Disease Control and Prevention's Guidelines Library[60]
- The European Centre for Disease Prevention and Control[61]
- Infection Prevention and Control Canada[62]

The World Health Organization *Surgical Safety Checklist* was created to improve the safety of patients undergoing surgical procedures around the world.[37] The checklist includes practice standards in three phases of the surgical process:

- Before the induction of anaesthesia (i.e., verify patient identity and procedure; verify and mark the correct surgical site; verify consent for surgery, equipment and instrumentation; etc.)
- Before skin incision (i.e., ensure all team members introduce themselves and their roles; confirm patient's name, procedure and surgical site; conduct time out before the procedure begins; etc.)
- Before the patient leaves the operating room (i.e., confirm name of surgical procedure; count the instruments, sponges and needles; confirm specimen labels, etc.).

In each phase of the surgical process, a checklist co-ordinator should confirm that the surgery team has completed the listed tasks before it proceeds with the operation, and that all three elements of the checklist has been confirmed by the surgery, anaesthesia and nursing teams.

The use of safety checklists in the operating room positively impacts patient morbidity and mortality after surgery.[50] When used appropriately, checklists also increase communication, encourage information sharing, identify knowledge gaps, and promote team cohesion, co-ordination and decision-making.[63,64] Effective use of the checklist depends on how effectively it is implemented. Common elements associated with successful implementation of checklists include leadership support, leadership messaging about willing engagement from providers (followed by mandatory enforcement, if required), the assignment of an implementation team, a burning platform for adoption of the checklist, extensive education, and team training.[65, 66]

The checklist can be used broadly to advance quality performance in cancer surgery and to enhance communication and team relationships. For example, a systematic review of the literature found that equipment-related failures account for a substantial proportion of all error occurring in operating rooms.[67] Procedures that rely heavily on technology appear to have higher equipment-related error rates. Cancer centres should consider developing a pre-operative equipment checklist-based system.

The *operating room culture and surgical team* are influenced by many factors, including the increasing complexity of procedures and sub-specialization, greater roles for non-medical staff, and an awareness of the need for both technical and non-technical skills in effective teamwork.[68]

A well-functioning and productive operating room culture produces high-functioning and productive operating teams. High-performing teams have more reliable and higher-quality outcomes.[69] A great deal of evidence links effective team communication with increased patient safety and improved outcomes.[70] The Joint Commission (2001) reported that although there were many root causes of wrong site, wrong person or wrong procedure surgery, the majority involved a breakdown in communication.[71]

Tactics that leaders should use to build a productive operating room culture and high-functioning surgical team include the following:

- Engaging all healthcare providers in planning, quality improvement and decisions about the daily operations of the operating room. Regular meetings of surgeons, anaesthesiologists and nurses should be used to discuss – frankly and openly – issues of concern about quality, safety, and efficient and effective care. Meeting chairs should alternate between the three professional groups to highlight the importance of every caregiver in the operating room.
- Collaboratively developing a code of conduct or team charter to help govern and manage communication and team relationships.
- Establishing a rotating lead team of the month, with representation from surgery, anaesthesia and nursing. The lead team should be responsible for resolving, by consensus, daily issues that arise.
- Instituting the Surgical Safety Checklist as a tool for improved communication and safety.
- Training healthcare providers about effective communication and how to contribute to the development of high-performing teams.[65]
- Evaluating the effectiveness of these tactics on improved operating room culture, team functioning and patient outcomes. More sophisticated tracking measures should be used, rather than just compliance with using checklists or attending team meetings.[70]

See the *Cancerpedia: Clinical Management* chapter for more information about interprofessional/ multidisciplinary teams.

Post-Operative Care Quality Practices

To advance quality surgical performance, cancer centres should hold regular quality of care conferences (QCCs) in the post-operative phase. These QCCs – also known as morbidity and mortality rounds or morbidity and mortality conferences – are usually held monthly, or more often if certain patient care issues need to be discussed. Everyone involved in the treatment of the patient whose care is being examined should attend. Discussions should be detailed, with open and frank examinations of the quality of care that was provided. Complications, deaths and adverse events should be fully examined, with the goal to identify policies and processes to help prevent recurrence, staff education opportunities and required practice changes. The conferences are held for the purposes of quality improvement and education, not for punitive reasons in cases of human error. See the *Cancerpedia: Clinical Management* chapter for more information.

Flow

The surgical care pathway is complex, as illustrated in Figure 1. A great deal of effort is required to plan, prepare and co-ordinate perioperative services so that patients receive safe, high-quality and timely surgical care, and so that resources (i.e., human resources, financial resources, equipment and facility infrastructure) are optimized.[1,72] Poor perioperative flow results in the poor use of resources, delayed or cancelled surgeries, increased surgical wait times, and high levels of patient and staff stress.

Examples of quality performance within each phase of perioperative care are provided in Table 5.

The use of process improvement methodology is a major tactic to improve perioperative quality and efficiency. One common approach is lean methodology, which was pioneered by Toyota and has since been adopted by manufacturing, service and healthcare industries. Using this approach, front line staff use a structured process to define value, map work steps, and identify and remove unnecessary steps in their work.[73]

A second common approach is Six Sigma, which was pioneered by Motorola and has also been adopted by other industries, including healthcare. Six Sigma uses quantified value targets and identifies and removes the cause of defects or errors to eliminate these defects and errors and minimize variability.[74] Aspects of both approaches can be used for quality improvements.[75] See Chapter 26, *Quality* for additional information. See the *Cancerpedia: Quality* chapter for more information. A third approach is the use of perioperative coaching teams to help assess issues, plan actions, implement performance improvements and evaluate success.[76]

Many programs are available to help hospitals improve the quality and efficiency of perioperative care. Examples include the following:

- The American College of Surgeons National Surgical Quality Improvement Program focuses on measuring and improving the quality of surgical care across surgical specialties in the private sector.[77]
- The United Kingdom's National Health Service Productive Operating Theatre program helps surgical teams work together more effectively, and helps operating rooms run more productively and efficiently.[78]
- The province of Ontario, Canada's Surgical Efficiency Targets Program measures and reports on perioperative performance. The program collects performance indicators in five major areas: start time accuracy; case time effectiveness; utilization; quality and safety; and scheduling.[79]

13. PERFORMANCE MONITORING, REPORTING AND QUALITY IMPROVEMENT

The surgical service must establish a system for quality and performance management and continuous quality improvement. Quality improvement includes the following:

Quality Framework

The cancer centre's perioperative quality framework should include broad domains for performance improvement, such as patient safety, staff satisfaction, and care that is timely, efficient, patient-centred, effective, accessible, equitable and appropriate.[80] These broad domains should align with the cancer centre's priorities and reflect the particular priorities of the surgical service. The selection of domains may also be influenced by the external priorities of national or subnational health ministries or organizations that focus on quality in cancer care or cancer surgery.

Table 5: Examples of Quality Performance Within Each of the Surgical Care Pathway[1]

Pre-Operative Care
- Patient arrives on time.
- Patient appropriately screened and ready for surgery.
- Patient provides consent.
- Patient receives information and is educated about their surgery and care.
- All diagnostic tests and investigations are completed and results are available.
- Patient chart is complete and reviewed.
- Discharge planning is initiated.
- Appropriate in-hospital and community-based supports are arranged for inpatients and outpatients, respectively.

Operative Care
- Patient is transported and in the operating room on time.
- Anaesthetist arrives on time.
- Surgeon arrives on time.
- All other surgical team members arrive on time.
- A full surgical team that is appropriate to the surgery is involved.
- Operating room is prepared and supplied appropriately for the surgery.
- All equipment is functioning.
- Sufficient time is scheduled for the surgery.
- Surgeries are scheduled using efficient practices (e.g., case blocks, appropriate number of cases per day, etc.)
- Flexibility is built in for emergency cases.
- Excellent communications and teamwork

Post-Operative Care
- Appropriate post-operative bed is available (i.e., PACU, ICU, inpatient care unit).
- Appropriate post-operative staff is available.
- Appropriate use of post-operative resources.
- Appropriate community-based services are available.

Examples include:

- Agency for Healthcare Research and Quality[81]
- The American College of Surgeons' Commission on Cancer and the National Surgical Quality Improvement Program®[77,82]
- Cancer Quality Council of Ontario[57]
- The Joint Commission[40]
- National Quality Forum[83]
- European Partnership for Action Against Cancer[84]

A wide range of clinicians and managers should have input into selecting the domains.

Quality Performance Indicators

The cancer centre's perioperative service should select quality performance indicators within each broad domain. As with the selection of domains, the selection of indicators should align with the cancer centre's objectives, reflect the priorities of the surgical service and may be influenced by the priorities of external bodies. A wide range of clinicians and managers should have input into selecting the indicators, and should have confidence in both the process used to select the indicators and the indicators themselves.

Quality performance measures that are most useful to clinicians include appropriate groupings of meaningful indicators, high-quality data obtained using a valid methodology and results that are published in a timely manner.[85] Indicators must be clearly defined, measurable and reliable. Indicator definitions may be adopted and/or adapted from other reliable sources, incorporate the use of evidence or benchmarks, and be used to manage and improve the quality of perioperative care.

Generally, quality performance indicators should consider structures, processes and outcomes.[86] For perioperative care:

- Structures are the settings where care takes place and the related supports (e.g., booking office, pre-admission clinic, POCU, operating room, intraoperative pathology and diagnostic imaging, central sterile supply, post-operative units, equipment, human resources, administrative structures, program operations and policies, etc.)
- Processes refers to the full range of perioperative care the patient receives and how it is provided (e.g., appropriate, complete, technically competent, guideline-based, safe, co-ordinated, acceptable, etc.)
- Outcomes refer to the patient's recovery, restoration of function and survival.

Other perioperative performance indicators should be considered that go beyond structures, processes and outcomes, such as accessibility, timeliness of care, cancer-related healthcare costs, quality-of-life metrics, and the patient-centredness of cancer care.[87]

Numerous perioperative performance indicators can be selected. The perioperative service should select a manageable number of indicators to track. Table 6 presents examples of quality performance domains and indicators for perioperative care.

Table 6: Examples of Quality Performance Indicators for Perioperative Care

Domains	Examples of Quality Performance Indicators
Accessibility	• Wait time for cancer surgery within priority rating target • Cancelled surgical cases and reasons why • Unplanned operating room closures and reasons why • Availability of cancer surgery to the population
Appropriateness	• Patients screened prior to surgery • Use of priority rating scale • Appropriate number and mix of staff for the surgery • Appropriate equipment and technologies for the surgery • Appropriate surgical case cart and instruments for the procedure • Number of operating rooms
Effectiveness	• Same-day admissions • Use of evidence-based surgical care • High-level team performance • Equipment functioning appropriately
Efficiency	• Pre-admission flow • Flow between pre-operative, operative and post-operative care • First case and subsequent case on-time start accuracy, and reasons for delays • Late operating room finish • Time to anaesthesia and to incision, compared to benchmarks • Surgical time booked compared to surgical time used • Turnover time of operating room • Per cent operating room utilization • Total surgeries • Average cost per case • Average cost per operating room hour
Patient-Centredness	• Patient satisfaction levels • Patient education and information
Safety	• Compliance with Surgical Safety Checklist • Adverse events in the operating room • Near misses in the operating room (e.g., unplanned event without injury, illness or damage, but with potential for any or all of these adverse outcomes) • Sterility break • Surgical site infection • Patient death in the operating room • Injuries in the operating room
Staff Work Life	• Staff satisfaction • Staff absenteeism • Staff efficiency • Incidents involving team relationships • Staff turnover • Overtime hours

Quality Infrastructure

A quality infrastructure with the following elements is needed to measure, monitor and improve perioperative performance. This should ideally be managed by individuals in positions that are objective, and who do not report directly to the healthcare team members affected by the data.

First, information management support is needed to collect, analyze and report on indicators. The timing of indicator collection may vary from just-in-time to weekly, monthly, quarterly, semi-annually or annually. Regular access to perioperative data and the ability to develop customized reports is critical to driving improvements. Customized performance reports may focus on discrete perioperative areas, particular surgical services, groups of surgeons or individual surgeons. It is best to provide performance feedback quickly and more frequently, so that care and process improvements can be made.[87]

Second, a perioperative performance accountability team – made up of key perioperative leaders (e.g., medicine, nursing and others) – should review the indicators in relation to evidence- and consensus-based

benchmarks, and best practice standards and guidelines. The team should engage staff to identify areas for improvement, establish improvement targets with associated timelines, develop action plans, support the implementation of change and track improvements.

Third, perioperative staff should receive ongoing training in quality improvement and patient safety, including best practices, adverse events (i.e., recognize, respond, report, disclose), and human factors. The latter includes factors that can influence people and their behaviour. In the cancer centre, these are environmental, organizational and job factors, and individual characteristics that influence behaviour at work.[88]

Finally, to promote transparency and continuous quality improvement, performance information should be communicated to those working in the perioperative service and, more broadly, to everyone in the cancer centre. Communication should include commentary on the data, expected plans of action and successes improving performance.

F. THE FUTURE

Surgical techniques to diagnose and treat cancer have, and will continue to, advance significantly. This has an impact on facility infrastructure and design, as well as implications for equipment, human resources and training requirements. This section presents major innovative trends in cancer surgery and describes their impact on surgical cancer services.

14. INNOVATIVE TRENDS

The traditional approach to surgery is an invasive operation performed by a surgeon, who makes a large incision through the skin and tissues to provide access to internal tissues or organs of interest. Traditional core surgical instruments used in interventional procedures include tools that perform functions like cutting, dissecting, grasping, holding, retracting or suturing.[89] Although the traditional approach to surgery continues to be appropriate for many cancer procedures, three major innovative trends have and will continue to influence the evolution of cancer surgery. These trends are presented separately for clarity, but are closely interconnected.

Less Invasive Surgery

Historically, advances in pharmaceuticals, intensive care medicine and anaesthesia supported the growth of large, invasive surgical procedures.[90] In the mid-1970s, groups of surgeons began to explore less invasive surgery, also known as keyhole and laparoscopic/thoracoscopic surgery.

Increasingly, surgeons are diagnosing, staging and treating cancer using minimally invasive and non-invasive surgery. A minimally invasive procedure involves making the smallest incision possible to support surgery. The surgeon may operate hands-on through the incision or insert miniature instruments through the incision into the body to perform the procedure. An example is laparoscopy, which involves inserting a laparoscope through a small incision. Non-invasive surgery penetrates the body, but does not cut or puncture the skin. Incisionless operations can include inserting specialized equipment through natural body openings (e.g., nose, mouth, rectum). An example is endoscopy, in which a flexible tube with a viewing lens or video camera and light is inserted through a body opening. Another example of non-invasive surgery is the use of ultrasound beams.

Incisionless operations – which break the physical barrier between surgery and bodily trauma – represent an epic revolution in surgery.[91] Less invasive surgical techniques result in less damage to healthy tissue. Generally, patients who undergo minimally or non-invasive surgery have less post-operative pain and discomfort, fewer post-surgical complications, shorter recovery times, and shorter or no in-hospital stays. It is important to consider that while these advances have been groundbreaking, the explosion of technological advances and the associated development of highly-sophisticated methodology has, at times, disregarded the ultimate objectives of cancer surgery.

The evolution of less invasive surgical techniques will continue, especially given the evolving use of equipment and technologies for surgery and increased collaboration with other treatment modalities.

Innovative Use of Technologies and Equipment

Surgeons have adopted and adapted technologies and equipment to help diagnose, stage and treat cancer in innovative ways.

Expanded Surgical Techniques

Surgeons have greatly expanded their surgical armamentarium. A prime example is the use of endoscopy as a surgical technique. Originally developed and used by urologists and gastroenterologists, surgeons eventually accepted endoscopy as part of the movement towards minimally invasive surgery and incorporated it into surgical thinking by the 1990s.[90] Endoscopy enables surgeons to view the gastrointestinal, respiratory, urinary and reproductive systems. It will continue to evolve with the use of miniature viewing lenses, video cameras and ultrasound devices attached to tubes that enable surgeons to take pictures of tumours, view tumours on external monitors, take biopsies, and destroy or remove abnormalities.

Other surgical techniques that will continue to evolve into the future include the following:

- *Laser surgery* uses powerful, focused beams of light radiation, rather than a conventional scalpel, to cut through tissue, destroy some cancers (i.e., especially small tumours), and seal vessels or tissue. Lasers can be used with fibre optics and special scopes, and can be focused precisely to minimize damage to healthy tissue. However, the use of lasers must be carefully evaluated, as initial use in some laparoscopic procedures (e.g.. laparoscopic cholecystectomy) has suggested that conventional cutting instruments are both just as effective and safer for the patient.
- *Microsurgery* uses operating microscopes that enable surgeons to see small components, such as small blood vessels and nerves. Microsurgery is used by a wide range of surgical specialties and has broad applications for cancer surgery.
- *Cryosurgery* destroys abnormal cells by freezing them with liquid nitrogen or a probe that is below freezing temperature. Surgeons use the technique for certain pre-cancerous and cancerous conditions. A scan helps guide the probe into the tumour and limits damage to healthy tissue.
- *Electrosurgery* uses high frequency electrical currents to destroy cells in some cancers.

Computer-Assisted Surgery

Computer-assisted surgery includes a wide range of innovations that use computer technologies to facilitate surgery. Examples include, but are not limited to, intraoperative imaging, image-guided surgery and, most notably, robotic surgery. In the latter instance, robotic systems controlled by a computer direct instruments in surgical procedures. The robotic system has various "arms," including a camera arm and various mechanical arms that work like human hands. Generally, the surgeon guides the procedure from a computer console, which can be near the patient or may be located remotely. The surgeon views the surgical area on a monitor and directs the mechanical arms, which are connected to the surgical devices.

Robotic surgery provides better control over surgical instruments, enables more precise movements, is less tiring for surgeons (who can sit while operating), and facilitates surgical procedures in areas of the body that are hard to reach using conventional surgical techniques. Robotic surgery can also be done remotely, which may be beneficial if a full range of subspecialists are not available in a cancer centre, and if adequate local assisting expertise is available. Remote surgery requires the necessary robotic equipment to be at both sites. Minimally invasive, robotically-assisted surgical procedures are increasingly being used to treat cancer, with good results.[92] It is important that the cost of these procedures be continually evaluated alongside the benefit to the patient.

Computer-assisted surgery will continue to revolutionize surgery. For more information, see the International Society for Computer Aided Surgery.[93] Computer technologies will also play an increasing role in the education of newly graduated and practicing surgeons through computer-assisted surgical simulations.

Surgical Simulation Technologies

In the past, surgeons acquired their skills in the operating room. Today – given the increasing complexity of surgery, the paramount importance of patient safety, and the need to use surgical time and resources effectively and efficiently – surgical skills are more commonly being taught using simulation technologies.

Surgical simulation technologies have the potential to decrease surgical risk, improve operating room efficiencies and fundamentally change surgical training.[94] Since surgical techniques are evolving rapidly and all surgeons need to be proficient in new procedures (e.g., minimally invasive surgical techniques), these technologies are being used to educate both medical trainees and practicing surgeons. Simulation technologies are also useful for evaluating new technologies, such as image-guided systems, in pre-clinical settings.

Multi-Treatment, Modality-Based Procedures

Increasingly, surgeons are working more closely with other treatment modalities – such as imaging and radiotherapy – to improve and refine the delivery of surgical procedures. When two or more treatment modalities come together, patients may receive more targeted and appropriate treatment for their cancer.

Image-Guided Surgery

Image-guided surgery uses real-time CT and MRI images to see exactly where cancerous and healthy tissue are located, and to guide the surgical procedure. Surgeons are better able to remove cancerous tissue and tumours, minimize damage to healthy tissue, monitor progress during surgery and determine if the entire tumour has been removed. Currently, intraoperative imaging is especially used during surgery for brain and pituitary cancers. Successful image-guided surgery requires an interprofessional/multidisciplinary team that includes surgeons, interventional radiologists and others.

Intraoperative Radiation Therapy

Intraoperative radiation therapy (IORT) involves delivering intensive radiotherapy during surgery. IORT can be used to treat cancers that are too hard to access or remove fully during surgery, are too close to vital organs for conventional radiotherapy to be delivered safely, or that may move within the body. IORT focuses radiation on a targeted area and helps preserve healthy tissue. IORT can be coupled with image-guided surgery. Successful IORT requires an interprofessional/multidisciplinary team that includes surgeons, interventional radiologists, physicists and others.

15. THE IMPACT OF INNOVATIVE TRENDS

Innovative trends have an impact on the design, planning and development of surgical cancer services.

From a physical facilities perspective, infrastructure must be designed to accommodate the capacity for surgical innovations, such as those described in this chapter. For example, specially-built operating rooms may be needed to accommodate and operate CT and MRI scanners (i.e., either in the room or in an adjacent room, into which the patient can be moved), provide imaging safely and allow additional professionals to work. The balance of inpatient and outpatient surgical space should be assessed, given that future technologies may enable more procedures to be performed in office-based clinics or purpose-built procedure rooms, rather than in full-service operating rooms. If centres are unsure of how to design operating space given future technologies, they are advised to shell in extra space that can be remodelled in the future or build in flexibility in their space designs.

Less invasive surgeries correlate to higher outpatient procedures rates, shorter hospital stays for inpatients and less need for post-operative support, such as nursing and rehabilitation care. All of this would suggest lower costs for the cancer centre; however, the use of innovative technologies, equipment, robotics and other computer-based systems require upfront capital investments in large equipment and systems, and ongoing funding operations, maintenance and training. In addition, costs may temporarily increase when technologies, equipment and procedures are being adopted, due to longer times to perform procedures and administer anaesthesia, and increased demands on staff resources.

The issue of patient preference has also become an important factor in the choice of procedure. In many jurisdictions – especially those with profit-making medical organizations – more expensive and highly-technical procedures are sought by patients regardless of proven outcomes, and are therefore provided at greater expense by the cancer centre. In other centres with greater cost and outcome monitoring, the provision of technological operations may be driven and adjudicated by governmental agencies that determine the value of such procedures.

Cancer centres must do their due diligence and conduct a cost-benefit analysis before adopting major innovations. For example, robotic surgery requires the purchase of a robotic system (i.e., robot, telemanipulator, computer), ongoing supply costs, and training for surgeons and technicians. A critical mass of patients, better outcomes and improved effectiveness and efficiency should offset the costs of any major investments.

The importance of training in new surgical techniques cannot be underestimated. There is growing experience suggesting that focused training is more important than the sheer number of operations performed when it comes to highly-specialized procedures, and that specialty operative training is associated with improved patient clinical outcomes.[95] In particular, surgeons already in practice need training to be proficient in new techniques. This training may be achieved in a variety of ways, including intensive, hands-on courses, locums focused on a specific procedure, formal re-training in a specialty, and even distance training employing telerobotic techniques.[96]

Innovative trends may impact the role of surgeons within the cancer centre. Surgical oncologists must understand the balance between surgical and non-surgical therapies for solid tumours, and be familiar with the wide range of treatment modalities so the correct modality – or combination of modalities – is selected by the interprofessional/ multidisciplinary team to meet the needs of the patient.[95] It has been suggested that a new, hybrid medical discipline may be emerging that combines the expertise of surgeons and other specialists, such as interventional radiologists and gastroenterologists; for example, the Institute of Image Guided Surgery's innovation program.[93] All of these specialists use minimally invasive and image-guided approaches to treatment.

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