CANCER PEDIA

CORE SERVICES/INFRASTRUCTURE

# INFECTION PREVENTION AND CONTROL

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CHAPTER

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# INFECTION PREVENTION AND CONTROL

## A. INTRODUCTION

Cancer patients are particularly vulnerable to infection due to their weakened immune systems. Those who are older, who have underlying illnesses, or who are undergoing multiple or complex treatments may be at further risk.

Infectious diseases have a significant impact on the quality of care and patient outcomes in hospitals. Hospitals can act as reservoirs for infectious disease, including antimicrobial-resistant pathogens. This increases the risk of infection exposure for cancer patients, who visit the hospital frequently as outpatients or remain as inpatients for extended periods of time. It is estimated that at any given time, one out of every 20 patients has a hospital-acquired infection. [1] Patients with infections tend to remain in hospital longer and experience increased morbidity and mortality. [2] [3] Furthermore, infections have an impact on readmissions, legal costs and the consumption of costly resources, such as staff hours, surveillance activities, laboratory testing, antimicrobial use and treatment, single room accommodations, protective equipment and other supplies. [4]

As such, it is extremely important for cancer centres to take measures that reduce the risk and transmission of infections. [5] Effective infection prevention and control (IPAC) programs greatly mitigate risks to patients and cancer centres. A meta-analysis of evidence conducted by Harbarth et al. (2003) suggested that at least 20 per cent of hospital-acquired infections are probably preventable through effective infection prevention and control strategies. [6] It has also been suggested that when healthcare facilities, healthcare teams, and individual physicians and nurses are aware of infection problems and take specific steps to prevent them, rates of some targeted hospital-acquired infections can decrease by more than 70 per cent. [7]

This chapter presents the key components of IPAC required in a cancer centre, including core activities, management structures and quality considerations.

## B. OVERVIEW

The purpose of the cancer centre's IPAC program is to identify all possible sources of infection and to enact appropriate measures that minimize the potential for infection transmission.

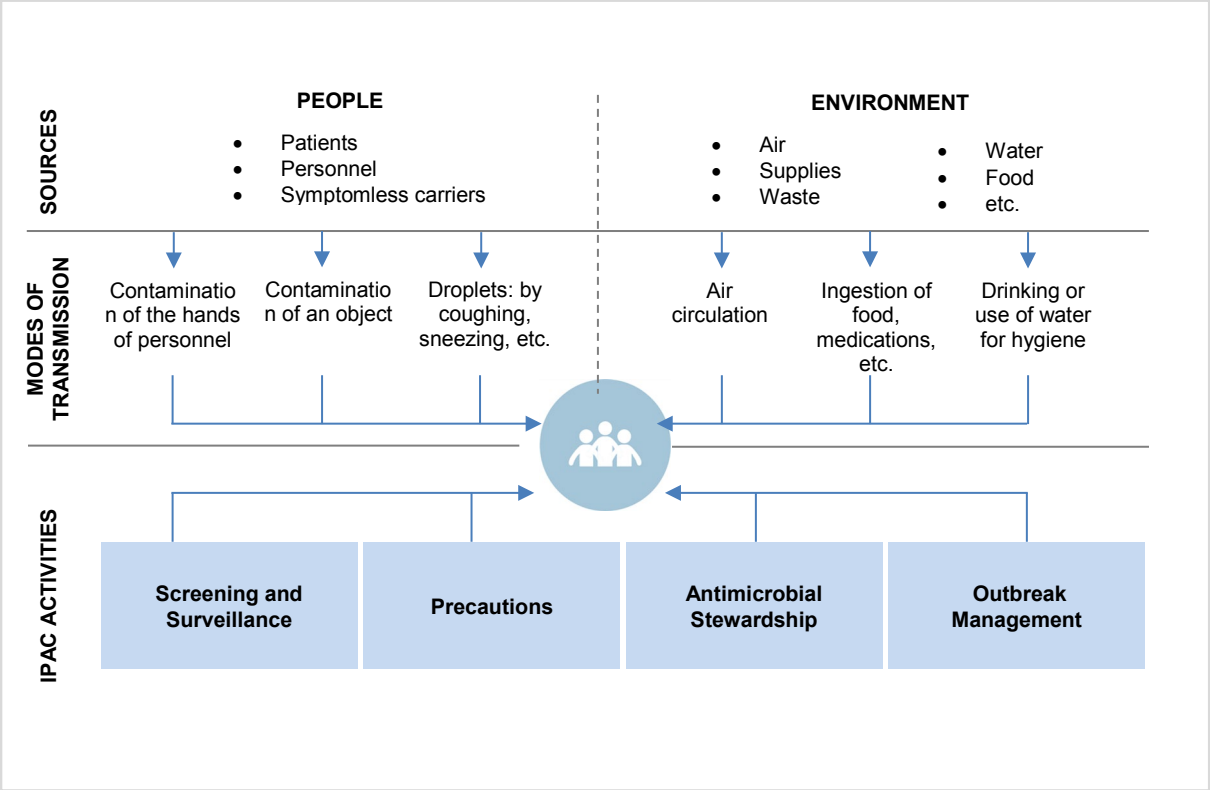
Sources of infection in a cancer centre include people (i.e., patients, personnel and symptomless carriers) and the environment (e.g., supplies, waste, water, food, etc.). Transmission from these sources occurs in three primary ways.

- ***Contact transmission*** occurs through touch, either directly between an infected person and another person or indirectly between a contaminated surface and a person.
- ***Droplet transmission*** occurs when large nuclei are expelled into the air by an infected person (e.g., through coughing, sneezing, laughing, talking) and inhaled by a nearby person. Droplets can travel up to two metres. [8]
- ***Airborne transmission*** occurs when small nuclei are expelled into the air by an infected person, travel on air currents (e.g., through ventilation) and are breathed in by others. Some infections can remain in the air for extended periods of time.

Infections may be transferred by more than one mode of transmission. In addition, it is possible for pathogens to be ingested through contaminated foods or water.

Figure 1 summarizes typical infection sources and modes of transmission in a cancer centre, as well as key infection prevention and control activities, which are discussed in further detail in this chapter.

Figure 1: Summary of Infection Sources, Modes of Transmission and IPAC Activities, adapted from World Health Organization [9]




## C. IPAC ACTIVITIES

The following measures are typically taken to prevent and control the risk and transmission of infectious diseases in a cancer centre. Infection control measures follow international, national and regional best practice standards and guidelines, but must always be adapted to meet the unique needs of the cancer centre environment.

### 1. SCREENING AND SURVEILLANCE

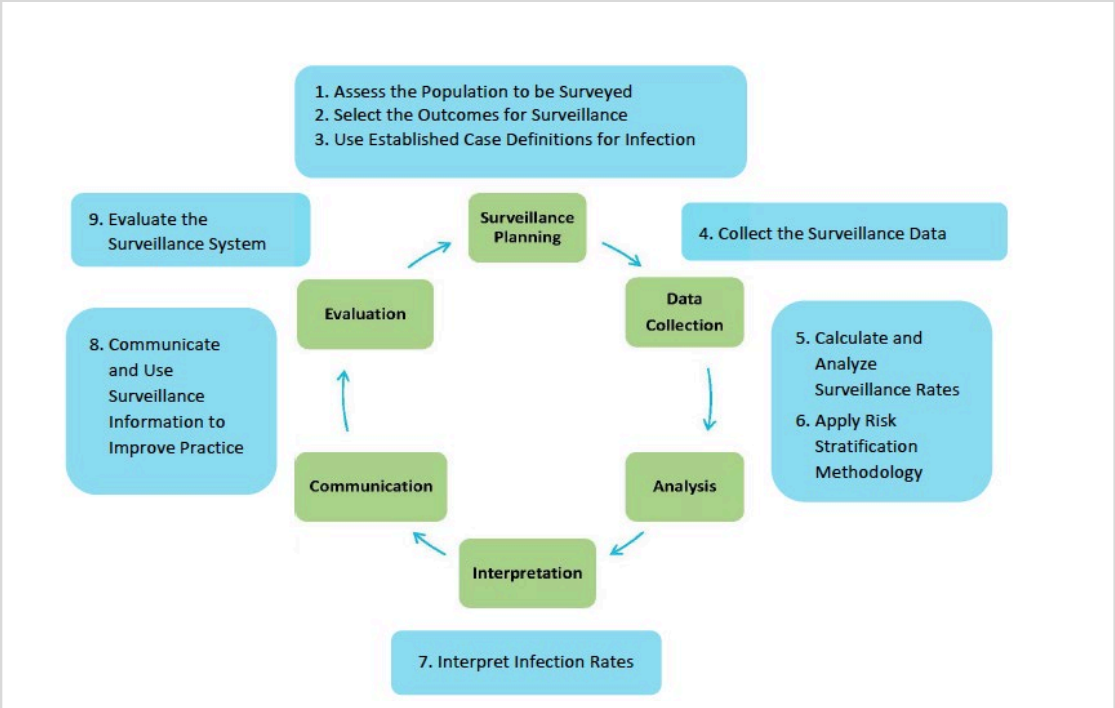
Healthcare staff, volunteers, patients and families who are infected with or carrying a potentially pathogenic organism can transmit the infection to others. Screening and surveillance help to identify risks early so that measures can be taken to limit the spread of infection and prevent outbreaks.

Screening helps to identify cases of infection or infection risk in the cancer centre. Information obtained from screening is an important source of surveillance data. Screening generally occurs in two ways:

- ***Passive screening*** includes self-screening and reporting of symptoms (e.g., prompted by signage, questionnaires, online or kiosk-based assessments, etc.) and the retroactive review of microbiological laboratory reports.
- ***Active screening*** includes staff-directed screening of patient and visitor symptoms at hospital entrances and registration areas, as well as routine testing of high-risk patients, healthcare providers and the environment for common or particularly harmful pathogens.

Common infections in a cancer centre include respiratory, enteric, fungal and central line-associated infections, as well as tuberculosis. Antimicrobial-resistant organisms, such as methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant enterococci (VRE), *Clostridium difficile* (C. diff) and multidrug resistant Gram-negative bacteria, may also be prevalent. Each cancer centre should undertake a process to plan, establish and maintain an effective surveillance program that is appropriate to the infection risks of its patient population and environment, as illustrated in Figure 2. Factors that may affect the structure of a surveillance program include the mandatory requirements of the jurisdiction, the incidence and communicability of organisms in the region, and the cost and effectiveness of interventions. [10] Surveillance programs must be continuously reviewed, adjusted and improved to address emerging infectious diseases and to align with advancements in cancer diagnosis and treatment.

Figure 2: Steps to Establishing a Surveillance Program [10]



A system is required to collect, track, analyze and report surveillance data; ideally, this system is electronic. Surveillance data may have many sources, including patient health records, laboratory reports, clinical rounds or sentinel surveillance systems, and typically includes:

- Tracking of key infections to identify surges and outbreaks early, and to allow for contact tracing and precautions
- Monitoring of events and outcomes (e.g., pathogens, syndromes, surgical site infections) to identify areas of healthcare improvement
- Monitoring of adherence to processes, procedures and/or standards of practice to identify areas of intervention

Surveillance data should be communicated broadly within the cancer centre and may also require reporting to external bodies that are responsible for infection prevention and control in the broader population. All surveillance reporting should include action plans to improve healthcare quality and safety.

For more information about screening and surveillance, see the following resources.

- The Provincial Infectious Diseases Advisory Committee's *Best Practices for Surveillance of Health Care-Associated Infections* [10]
- The Association for Professionals in Infection Control and Epidemiology's *Recommended practices for surveillance* [11]
- The Centers for Disease Control and Prevention's National Healthcare Safety Network [12]

## 2. Standard Precautions

Standard precautions are a basic level of infection prevention and control measures that should be used throughout the hospital and for all patient care. They are intended to reduce the transmission of infection from both known and unknown sources. Many cancer patients move between the cancer centre and the community frequently, as well as between outpatient and inpatient care. This frequent movement combined with the cancer patient's immunocompromised status and tendency to shed infection over a longer period of time make standard precautions paramount in a cancer centre setting.

Standard precautions include point-of-care measures, environmental measures and administrative measures, as summarized below. For more information about standard precautions, see the following resources.

- The World Health Organization's *Infection control standard precautions in health care* [13]
- The Centers for Disease Control and Prevention's infection control basics [14] and *Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings* [15]
- Public Health Ontario's *Routine Practices and Additional Precautions* [16]

### Point-of-Care Measures

Point-of-care measures include precautions that minimize the risk of infection transmission between healthcare providers, patients and visitors. To ensure the appropriate selection of point-of-care measures, healthcare providers should conduct an assessment before each

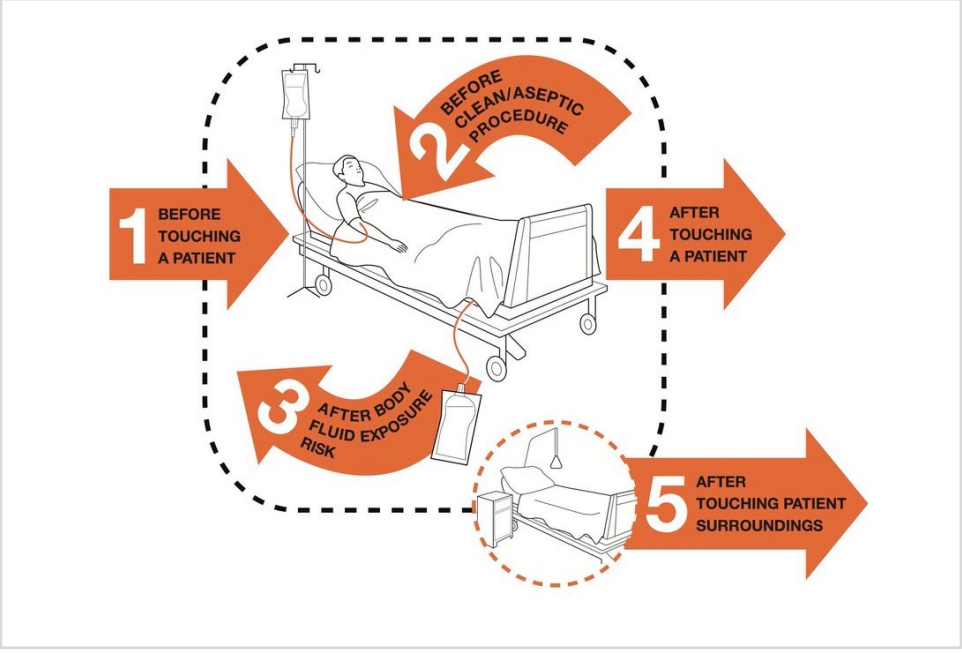
patient interaction to determine specific situational risks, such as the type of infection, the care activities to be conducted and any anticipated exposure. Several important point-of-care measures are discussed in further detail below.

### *Hand Hygiene*

Healthcare providers continuously come into contact with patients, fluids, waste, food and objects throughout the day. It is well understood that "the hands of health care providers are the most common vehicle for the transmission of microorganisms between patients, from client/patient/resident to equipment and the environment, and from equipment and the environment to the client/patient/resident." [17] In order to limit contamination and infection, a formal, robust and multidisciplinary/interprofessional hand hygiene program must be in place in all healthcare settings.

Hand hygiene encompasses any action of cleaning that removes or kills visible soil and transient microorganisms from the hands while maintaining skin integrity. It is typically accomplished through the use of 70 to 90 per cent alcohol-based hand rub when hands are not visibly soiled and through hand washing with soap and running water when hands are visibly soiled. Healthcare providers are expected to practice hand hygiene before and after every patient interaction and procedure, as illustrated in Figure 3. Patients and visitors should also be prompted to perform hand hygiene regularly to prevent the spread of infection, through visual alerts in key areas and/or education, as appropriate

Figure 3: World Health Organization Five Moments for Hand Hygiene [18]




In addition to appropriate hand cleaning, an effective hand hygiene program should consist of the following supportive elements: [17]

- An assessment of staff readiness and cultural influences related to implementation
- A written policy and procedure regarding hand hygiene

- Easy access to hand hygiene agents at the point-of-care (i.e., 70 to 90 per cent alcohol-based hand rub)
- Education that includes indications for hand hygiene, techniques, guidance for different types of hand hygiene agents and hand care in general
- Education in the appropriate selection, limitations and use of gloves (e.g., gloves are not a substitute for hand hygiene)
- Access to free-standing hand washing sinks dedicated to hand hygiene, and used for no other purpose
- A hand care program
- Patient and caregiver engagement and education
- A program to monitor, evaluate and improve hand hygiene compliance, with feedback to individual employees, managers, chiefs of service and the Medical Advisory Committee/Professional Advisory Committee

Random audits can be a particularly manageable and effective way to assess and improve hand hygiene compliance. Additionally, evidence exists that environmental supports for hand washing can greatly increase compliance. [19] These supports may include providing numerous, visible and conveniently located alcohol-rub dispensers, hand washing liquid dispensers and washing sinks, preferably with hands-free faucets. [20, 21] Hand hygiene facilities should be located at all hospital entrances, in examination and procedure rooms, at nursing stations, immediately outside of patient rooms and inside patient rooms. Co-located signage or other visual cues can help to educate patients, families and visitors about the importance of hand hygiene and increase hand hygiene compliance.

For further examples of effective hand hygiene programs, see the following resources.

- The World Health Organization's *Guidelines on Hand Hygiene in Health Care* [22]
- The Institute for Healthcare Improvement's *How-To Guide: Improving Hand Hygiene* [23], *Hand Hygiene Monitoring Tool* [24] and *Contact Precautions Monitoring Tool* [25]
- Public Health Ontario's Just Clean Your Hands program[26]

### *Personal Protective Equipment*

Personnel and visitors should don appropriate personal protective equipment (PPE) upon entering a patient space and properly discard PPE upon leaving the space. Appropriate PPE varies by the anticipated type of exposure and may include gloves, gowns, masks, eye protection, face shields and respirators. Signage at the entrance to patient spaces should provide indications for patient-specific PPE. For more information about PPE requirements, see the Centers for Disease Control and Prevention's Protecting Healthcare Personnel resources and the World Health Organization's personal protective equipment page. [27, 28]

### *Safe Patient Care Practices*

Healthcare staff should adhere to safe practices when performing patient procedures, such as safe injection practices and the safe handling of sharps. Appropriate support for patient hygiene activities, such as regular bathing, can also help to reduce the risk of infection.

## Environmental Measures

Environmental measures include precautions that minimize the risk of infection transmission from physical facilities, equipment, food or water. Hospital support services enact environmental measures that help keep the hospital clean and safe for patients, visitors and staff. Several important environmental measures are discussed in further detail below.

### *Cleaning*

Cleaning includes a wide range of critical activities that contribute significantly to controlling infection. These activities include: [29]

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

Cleaning removes visible organic and inorganic soil from surfaces using manual or mechanical processes that involve dissolving and diluting soil with water, using agents (e.g., detergents) to make the soil more soluble, and rinsing and drying surfaces. [30, 31] Cleaning also removes soiled items, some of which may be reusable (e.g., linens) and some of which may need to be discarded as waste. A linen and laundry service should manage the procurement, washing, cleaning, disinfection and distribution of linen and laundry to all areas of a cancer centre.

Thorough cleaning removes more than 90 per cent of microorganisms, whereas poor cleaning may actually spread these organisms. [32] All cleaning activities must follow best practice standards and guidelines for the protection of patients and staff, as well as recommendations from the manufacturers of equipment and devices. Effective cleaning should be standardized and, where possible, automated to minimize variability in cleaning technique. [31]

For more information about cleaning best practices, see Public Health Ontario's *Best Practices for Environmental Cleaning for Prevention and Control of Infections in All Health Care Settings, 3rd Edition*. [29]

### *Disinfection and Sterilization*

Disposable or dedicated patient care equipment is ideal, when possible. Patient care equipment and instruments specifically intended for reuse need to be properly cleaned and disinfected or sterilized, as appropriate, before they are used with another patient.

Disinfecting and sterilizing equipment and instruments used in surgical, medical and other procedures is necessary to control the transmission of infection to patients. Disinfection eliminates many or all pathogenic microorganisms excluding bacterial spores, generally using liquid chemicals or wet pasteurization. Sterilization destroys or eliminates all forms of microbial life using physical or chemical methods.

Standards may vary by jurisdiction. Cancer centres should base their practices on the latest evidence-based standards. As well, manufacturers' recommendations for disinfecting and sterilizing equipment and devices should be followed; for example, high-level disinfection is the minimum standard for laparoscopes and arthroscopes between patients, though ideally instruments entering sterile tissue should be sterilized. [30]

When establishing IPAC procedures and processes, facilities must be aware of factors that affect the efficacy of disinfection and sterilization including: [30]

- Prior cleaning of the object, and the extent of organic and inorganic soil that should have been cleaned off
- The type and level of microbial contamination
- The physical nature of the object (e.g., crevices, hinges and lumens)
- The presence of biofilms
- The concentration of, and exposure time to, the germicide
- The temperature and pH of the disinfection process
- In some cases, the relative humidity of the sterilization process

In addition, specific disinfection and sterilization policies and procedures should be developed for situations that carry a higher risk of infection transmission, including the use of equipment between hospitals, the transportation and handling of devices, immediate-use steam sterilization and improperly processed equipment.

It is ideal for disinfection and sterilization to be managed centrally. For more information about the infrastructure requirements of a central sterile supply department, see the *Cancerpedia: Surgery* chapter. For disinfection and sterilization guidelines, see the Centers for Disease Control and Prevention's disinfection and sterilization resources or the World Health Organization's *Decontamination and Reprocessing of Medical Devices for Health-Care Facilities*. [30, 33]

### *Waste Management*

Cancer centres generate a wide range of waste that must be collected, stored and disposed of safely and appropriately to control the risk of contamination. Waste results from diagnostic activities, treatments, procedures, staff and patient-related activities, and facility functions.

Infectious waste contains pathogens and poses a risk of disease transmission. It may include contaminated materials (e.g., materials contaminated with body fluids, laboratory cultures and microbiological stocks, materials that have been in contact with infected patients) [31], sharps waste or pathological waste (e.g., tissues, organs, body parts, blood, body fluids, etc.).

Standards for managing infectious waste and protecting staff and patients can vary by jurisdiction. For more information, see the World Health Organization's health-care facilities and waste resources. [34]

### *Food Safety*

Contaminated foods are a common source of infection. In cancer centres, immunocompromised and weakened patients are susceptible to infection by a wide a range of food-borne pathogens, such as salmonella, norovirus, *E. coli* and listeria. [35] Food must be safely prepared, handled, stored and distributed to minimize the risk of food poisoning due to contamination.

Potential sources of food poisoning include: [36]

- Contaminated foodstuffs
- Contaminated equipment (e.g., food preparation stations and materials, food distribution equipment)
- Inappropriate storage (e.g., inappropriate temperature, humidity or length of storage; cross-contamination between raw and cooked food)
- Inadequate IPAC procedures (e.g., improper cleaning; improper food preparation, including washing, cooking, reheating and cooling food; improper food handling, including hand washing and waste disposal)

Standards for safe food management may vary by jurisdiction. National or subnational bodies – such as government branches or agencies dedicated to food safety – often establish standards and legislation for this purpose. These standards must be applied to both the cancer centre's food service as well as any on-site food vendors. On-site food vendors may be selected to reinforce food safety standards for immunocompromised patients; for example, vendors that serve raw fish may be excluded from areas serving cancer patients. All patients should receive advice and counselling on food safety.

For more information, see the World Health Organization's food safety resources. [37]

### *Facility Construction, Design and Maintenance*

Physical facilities can be designed and constructed to separate potential sources of infection from non-infected patients and patient care areas, and to help reduce the number of routes that infection can be transmitted. Infection prevention and control professionals should be active participants in the design, construction and renovation of the cancer centre's physical facilities. [20]

The ability to physically segregate patient flow may be necessary to minimize the spread of infection in a cancer centre. Facility design should include separate functional care areas and departments, positive pressure protective environment rooms, negative pressure airborne isolation rooms and combination protective environment/airborne isolation rooms, as needed. Private patient rooms can also reduce the likelihood of spreading infection and are strongly recommended. [19, 21, 38] In addition, separate corridors, stairways, elevators and storage are required to transport and hold the clean (i.e., non-contaminated) and dirty (i.e., potentially contaminated) supplies and equipment used in patient care.

An important aspect of facility construction is the selection of materials and fixtures to help control infection, including appropriate materials for all surfaces (e.g., floors, walls, ceilings,

furniture). Construction and design materials should be free from, and resistant to, contaminants (e.g., water, microbes, mold) and minimize aerosolization. Furthermore, surface materials should be smooth and monolithic, nonporous, fluid- and moisture-resistant, sealed where there are joints, undamaged, durable, easy to clean and able to withstand repeated disinfection. For example, the use of dry floors (i.e., as opposed to carpet), wipeable, non-porous furniture, and fixtures with a minimum likelihood of dust accumulation are recommended. [20] Careful section of plumbing fixtures is incredibly important to prevent exposure to contaminated water sources. For example, sink design should incorporate aerator-free faucets, offset faucets and drains, sink bowls shaped to minimize splash-back to users and supplies, and hands-free operation.

Lack of ventilation, low ventilation rates and inadequate air filtration are associated with increased infection rates or outbreaks of airborne diseases. [39] Ventilation systems must ensure that there is sufficient air exchange and air directionality or pressurization in pressure-critical areas (e.g., isolation rooms, sterile processing areas, operating rooms). The airflow direction and pressure differential shall be such that air movement is always from clean areas to less clean areas. [40] High-efficiency particulate arrestance (HEPA) air filters are highly effective in preventing airborne infections from entering the hospital. [19] Strong consideration should be given for the HEPA filtration of air servicing positive protective environment rooms. Ventilation systems must be designed, installed and maintained to the highest of heating, ventilation and air conditioning (HVAC) standards.

Cancer centres must also ensure that their water supply is safe. Waterborne infections can spread in many ways, including direct contact, the ingestion of contaminated water or the inhalation of aerosols dispersed from water sources. [19] Plumbing systems must be properly designed, installed and maintained in accordance with national and local codes and regulations. Special requirements for plumbing systems in healthcare facilities may be required in order to protect susceptible occupants from infectious diseases, hazards created by improper temperatures, leaks, inadequate drainage and adverse conditions created by the failure or improper operation of plumbing systems. [20]

All materials and systems should be regularly cleaned, tested and maintained to prevent the spread of infections.

For more information about hospital design and facilities considerations, see:

- The CSA Group's *Canadian health care facilities* and *Infection control during construction, renovation, and maintenance of health care facilities* standards [41, 42]
- The Facility Guidelines Institute (United States) [43]
- The *Cancerpedia: Physical Facilities Design and Management* chapter

**Administrative Measures**

Administrative measures include precautions that minimize the overall risk of infection transmission in the hospital through education, special programming, policies and quality initiatives. Several important administrative measures are discussed in further detail below.

### *Patient Education*

Many immunocompromised cancer patients come to the cancer centre as outpatients for appointments and treatments. Patients should receive IPAC education to help them minimize the risk of infection and infection transmission when coming to the hospital, at home and in the community. This may include information and instruction relating to hand hygiene, personal care, food safety and other precautions. For more information about patient education, see the *Cancerpedia: Patients* chapter.

### *Respiratory Hygiene Program*

Patients, visitors and staff should be asked to practice respiratory hygiene, such as covering the nose and mouth when coughing or sneezing, performing hand hygiene after coming into contact with respiratory secretions, and using and properly disposing of facemasks when symptomatic for a respiratory illness. Prompts may include visual alerts at cancer centre entrances or education, as appropriate.

### *Staff Education*

Education is critical to the adoption of information, the training of healthcare staff, and the ability to implement innovations and new knowledge. The need for learning can range from awareness of information to intensive training programs designed to increase competence and enact changes in practice.

All cancer centre staff should receive education in standard precautions that help to minimize the risk and transmission of infection. Additional education is required for front line staff who care for infectious patients. For more information about staff education, see the *Cancerpedia: Education* chapter.

### *Occupational Health and Safety Programs*

A variety of programming should be developed to keep staff healthy and safe, as appropriate to the environment. At a minimum, cancer centres should aim to establish a mandatory staff vaccination program as well as a post-exposure to injuries program that mitigates adverse events.

For more information about administrative measures, see the *Policies, Procedures and Processes* and *Quality* sections of this chapter.

## 3. Transmission-Based Precautions

Transmission-based precautions are used in addition to standard precautions for patients and personnel who have been confirmed as infectious, who are showing symptoms of infection, or who have come into contact with an infected person or environment. These precautions are specific to the type of infection and its modes of transmission. Transmission-based precautions typically include the following.

- ***Appropriate placement of patients:*** Patients requiring additional precautions should be placed in a single patient room or space, whenever possible. Some patients may require private bathroom facilities to prevent the spread of infection. Patients infected with airborne pathogens must be placed in a private room with negative pressure ventilation. For more information about patient rooms, see the *Cancerpedia: Inpatient Care* chapter
- ***Limited transport and movement of patients:*** Infected patients should remain in their rooms to the extent possible and be moved only for medically-necessary purposes.
- ***Restriction of visitors and personnel:*** Visitors who are infectious should be discouraged from coming to the cancer centre. Similarly, work restrictions must be established for infected staff and volunteers to prevent infection transmission to patients. Personnel who lack immunity to certain diseases may be restricted from working with infected patients if qualified staff who are immune are available.
- ***Immunization programming*****:** Immune-susceptible patients and visitors should be vaccinated as soon as possible following unprotected contact with vaccine-preventable infections.

For more information about precautions for specific pathogens, see the Centers for Disease Control and Prevention's *Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings*. [15]

### 4. Antimicrobial Stewardship

Antimicrobials are a very important line of treatment for cancer patients, many of whom are immunocompromised and prone to infection. However, there are clear links between the use of antimicrobials and the rise of antibiotic-resistant pathogens that cause untreatable infections. [44]

Antimicrobial stewardship programs – which typically include a variety of educational, clinical management and quality improvement measures – aim to improve and optimize antimicrobial therapy and clinical outcomes for patients, while reducing the risks of antimicrobial resistance. [45] Many jurisdictions now require that all acute care facilities have an antimicrobial stewardship program.

For further information about antimicrobial stewardship in hospitals, refer to the Infectious Disease Society of America and Society for Healthcare Epidemiology of America's guidelines. [46]

### 5. Outbreak Management

Effective IPAC can help to prevent, mitigate and identify outbreaks of infectious disease in a timely way. However, even when proper measures are observed, outbreaks may occur. An outbreak is an incident in which a group of people linked in time and space experience a similar illness in excess of normal expectancy. Thresholds differ by pathogen. Outbreaks may originate within the cancer centre or outside of the cancer centre, and often happen suddenly. [47] Effective surveillance, reporting, and advance preparedness are all essential to limiting and managing outbreaks. This is especially true in a cancer centre, where patients are more prone to infection and tend to shed infections for a longer period of time.

Outbreak management must be a key component of the hospital's emergency plan. In addition, the cancer centre should establish an outbreak management team with interprofessional/multidisciplinary representation, including members of the IPAC team, medical personnel, facilities staff and administrative supports.

In co-operation with front line staff, the outbreak management team is responsible for overseeing all aspects of an outbreak, including identifying the outbreak, reporting the outbreak to the organization and the local public health authorities, leading efforts to control the outbreak, and liaising with public health authorities in the event of a broader epidemic or pandemic, as appropriate.

For more information about outbreak management, refer to the World Health Organization's:

- *Guidelines on Prevention and Control of Hospital Associated Infections* [48]
- *Hospital Preparedness for Epidemics* [49]
- *Outbreak communication guidelines* [50]

## D. MANAGEMENT

### 6. LEADERSHIP

Infection prevention and control occurs primarily at the front line of care, where staff regularly come into contact with patients and visitors. All cancer centre staff have a role in, and responsibility for, taking appropriate measures to minimize the risk and transmission of infection.

Cancer centre leadership are ultimately accountable for organization-wide infection prevention and control management, including policy-setting, issues mitigation, and continuous quality and performance improvement. Leadership should establish an IPAC committee to provide specialized oversight and governance of IPAC activities and report to senior leadership. At a minimum, the committee should include a senior physician, a clinical microbiologist, an IPAC practitioner, an antibiotic specialist and a director of environmental services. [31]

In addition, cancer centre leadership should establish a formal IPAC service, to provide specialized IPAC expertise and to operationalize IPAC activities. The IPAC service is typically led by a director or manager who oversees dedicated IPAC staff. Since effective IPAC is a hospital-wide effort, responsibility for implementing and monitoring IPAC best practices should also involve directors and managers of environmental and facility services, occupational health and safety, nursing, medical services, central processing, and all other areas that influence infection prevention and control. [4]

Finally, leaders must allocate sufficient resources to support an effective IPAC program. These resources include appropriately trained IPAC staff and educators, sufficient equipment and supplies, and provisions for surge capacity in the event of an outbreak. The level of resources should be proportional to the size, acuity, complexity, activity and estimated risk of the populations that are being served by the cancer centre. [4]

## 7. Human Resources

Many jurisdictions have programs that administer certification programs and set core and ongoing professional competency education standards for IPAC professionals. Requirements vary by jurisdiction, but generally include a post-secondary or higher degree in addition to infection prevention and control experience. Examples of certification organizations include the following:

- The Certification Board of Infection Control and Epidemiology (CBIC), which offers the most widely-recognized examination for IPAC professionals in North America. [51]
- Infection Prevention and Control Canada, which partners with CBIC. [52]
- The International Federation of Infection Control, an umbrella organization of societies and associations of healthcare professionals in IPAC and related fields. [53]

All IPAC programs must include certified infection prevention and control professionals as well as administrative staff. [4] Research has found that the effectiveness of IPAC programs is improved by the active participation of physicians with IPAC expertise and experience. [4] Typically, IPAC physicians are microbiology and/or infectious disease specialists with additional postgraduate training in infection prevention and control. Some jurisdictions recognize IPAC as a medical specialty or subspecialty.[54] In addition, it is ideal for the service to include an epidemiologist or access to a professional with epidemiological knowledge.

Establishing relationships with IPAC champions in clinical programs and departments aids the IPAC team in carrying out its mandate.[4] Sufficient numbers of laboratory, environmental services, and occupational health and safety staff are required to support program activities (e.g., implementing additional precautions, managing outbreaks, immunization). For more information about support services, see the *Cancerpedia: Physical Facilities Design and Management* chapter.

Finally, all cancer centre staff must be competent in IPAC practices. Regular education and support to help staff consistently implement appropriate IPAC practices are essential.[4]

## 8. Operating Standards and Guidelines

The IPAC service must meet a wide range of operating standards and guidelines set by various organizations. A cancer centre must comply with all IPAC and health and safety legislation and regulations for the jurisdiction in which it operates. Generally, accreditation standards and guidelines relevant to IPAC address:

- Organizational practices, such as infection prevention and control activities
- Resourcing (e.g., appropriate and sufficient equipment, supplies, qualified human resources)
- Environmental safety (e.g., planning, design and construction of facilities, environmental cleaning, waste management, etc.)
- Quality improvement
- Staff and patient education

For examples of accrediting bodies in healthcare – many of which include IPAC – see the

International Society for Quality in Health Care (ISQua) membership section. [55]

## 9. Policies, Procedures and Processes

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 cancer centre's operating policies should reflect accreditation operating standards and guidelines.
- Processes set out what the cancer centre will do to achieve its policies. Processes usually identify who is responsible for performing the process (e.g., department), and the 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 must establish policies, processes and procedures, and make these readily available to all staff, students and volunteers, along with training, as required. Standard operating procedures (SOPs) should be regularly assessed for their ongoing relevance and effectiveness (i.e., annually, at a minimum) and updated. Document control is critical to ensure that the most updated versions of policies, processes and procedures are being used. An electronic system is preferable as the number of SOPs increases.

Examples of areas requiring policies, processes and procedures to support IPAC include:

- ***Hand hygiene:*** use of products; appropriate practices; signage and education; monitoring
- ***Respiratory hygiene:*** appropriate practices; signage and education
- ***Personal protective equipment:*** appropriate use and practices
- ***Handling of sharps:*** safe practices; disposal
- ***Environmental maintenance:*** cleaning protocols; disinfection and sterilization protocols; management of single-use devices; waste management protocols; construction standards; facilities management standards
- ***Risk assessment:*** patient risk assessment; provider risk assessment
- ***Pathogen-specific prevention and control measures***
- ***Patient isolation*****:** appropriate practices; additional precautions; discontinuation of precautions
- ***Outbreaks*****:** monitoring; reporting; management

## 10. Data-Informed Management Decisions

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

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.

Health technologies, such as electronic health records, may facilitate the collection of surveillance data, provide for the collection of risk-adjusted patient outcomes and facilitate infection control interventions at the point of care.[56] The ability to store and analyze data electronically also reduces the chance of human error and allows for a better understanding of infection rates at the unit or department level.

Table 1: Examples of IPAC Indicators and Management Analysis

| Area | Indicator | Management Analysis |
|---|---|---|
| Adherence to Protocols and Best Practices | • Adherence to screening protocols for patients and employees<br>• Adherence to routine best practices and protocols (e.g., hand hygiene, personal protective equipment, ventilator use, etc.)<br>• Adherence to best practices for cleaning, disinfection and sterilization | • Rate of compliance compared to target, analysis of non-adherence and improvement tactics |
| Infections and Injuries | • Number of infections (e.g., by type, location)<br>• Number of sharps injuries | • Rate of infections, analysis of causes and improvement tactics<br>• Rate of injuries, analysis of causes and improvement tactics |
| Occupational Health and Safety | • Vaccination rates of staff (e.g., annual influenza)<br>• Sick days due to infectious conditions | • Analysis of vaccination rates and improvement tactics<br>• Analysis of sick days |

## E. QUALITY

### 11. Standards, Guidelines and Best Practices

IPAC standards, guidelines and best practices may originate from various international, national and subnational organizations and bodies. Although cancer centres may develop local IPAC best practices, these should generally align with the national and subnational standards and guidelines of the jurisdiction in which the cancer centre is located.
Examples of leading organizations that have developed evidence-based standards of practice for quality infection prevention and control include:

- The World Health Organization [57]
- The Centers for Disease Control and Prevention [58]
- The European Centre for Disease Prevention and Control [59]

For a list of national organizations dedicated to IPAC, see the International Federation of Infection Control.[53]

For standards, guidelines and best practices relating to specific clinical and non-clinical services, see the appropriate *Cancerpedia* chapter.

### 12. Performance Monitoring, Reporting and Quality Improvement

The IPAC service must establish a system for quality performance management and continuous quality improvement that includes the following:

- An IPAC quality framework to guide performance improvement efforts.
- Quality performance indicators that align with the quality framework and that consider structures, processes and outcomes. [60]
- An infrastructure to collect data, monitor and report on performance, and target areas for improvement.

Information management support is needed to collect, analyze and report on indicators. An IPAC performance accountability team – which may be the interprofessional/multidisciplinary infection control committee identified earlier – 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. The team should also monitor infection rates to identify trends, clusters and outbreaks above baseline levels, and address areas of concern. Staff should receive ongoing training in quality and improvement, including best practices and processes.

To promote transparency and continuous quality improvement, performance information should be communicated to each area responsible for IPAC activities and, more broadly, to everyone in the cancer centre. Communications should include commentary on the data, expected plans of action and successes improving performance. Conversely, it is important for IPAC staff to be aware of developments throughout the cancer centre, so as to ensure that the quality improvement program is appropriately aligned to emerging issues and advancements in care.

## F. THE FUTURE

Infection risks are ever-changing. While the number of outbreaks has increased worldwide over recent decades, outbreak cases per capita appear to be declining as approaches to IPAC improve. [61] Unique diseases, however, are also on the rise, and infectious diseases previously considered eliminated in many countries have seen a resurgence with the movement towards vaccine refusal. [61, 62] Sophisticated surveillance will continue to be important as both human behaviours and pathogens evolve, presenting new risks to human health.

With the rise of electronic health records and mobile, internet-enabled technologies, many cancer centres now have an ability to collect and store vast amounts of clinical data. While traditional approaches to surveillance have relied mainly on retrospective analysis, artificial intelligence (AI) is now showing promise for epidemiological modelling that is more predictive in nature, including a more time-sensitive and precise ability to forecast outbreak trajectories. Moving forward, it is expected that AI will play an essential role in outbreak prevention.

AI is also being used in the trend towards personalized approaches to diagnostics and treatment. For example, major vendors have begun the bioinformatics analysis of B- and T-cell

receptors in an effort to create a human receptor/antigen map. If successful, the effort could result in a universal blood test that can scan the human immune system for a wide variety of diseases, including infections. [63]

As testing for infections becomes more sensitive and newer, more targeted therapies are developed, it is important to consider the unintentional creation of new infection control risks. For example, the effect of immunologic therapies on the epidemiology of the cancer population is currently unknown. Cancer centres must be vigilant in their approach to new treatments and monitor patients carefully for unexpected impacts.

## G. SUGGESTED READING

- The Association for Professionals in Infection Control and Epidemiology's topic-specific infection prevention resources [64]
- The International Society of Infectious Diseases' guide to infection control in the healthcare setting [65]
- The National Institute for Health and Care Excellence's infection prevention and control guidance [66]
- The World Health Organization's infection prevention and control resources [67]

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