CANCER PEDIA

CLINICAL SERVICES

PHARMACY

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CHAPTER
18

PHARMACY

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A. INTRODUCTION

The pharmacy service plays an essential role in supporting the delivery of cancer-related diagnostics, procedures and drug treatments, especially chemotherapy. The vast majority of cancer patients receive medications as part of their care.

A healthcare facility's pharmacy service is responsible for safe and effective medication practices, which include: procuring drug products and managing their inventory; preparing, packaging and labelling medications; delivering medications; optimizing medication therapy; adhering to policies on medication use and monitoring usage; evaluating the effectiveness of the medication-use system; and conducting research.[1] The pharmacy service also plays an important role in patient care, such as providing consultation, information and advice, and aiding in the selection of pharmaceutical therapies.

The complexity of caring for cancer patients, the cost of chemotherapy, the potential for toxicity and medication errors, and the need for the safe preparation, administration, and disposal of cytotoxic drugs highlight the important role of pharmacies in cancer centres, regardless of a country's resource level.[2]

B. OVERVIEW

The cancer pharmacy service may be part of, or separate from, the hospital's general pharmacy department. All pharmacies in large healthcare centres tend to have similar functions, roles and responsibilities, as outlined below.[3]

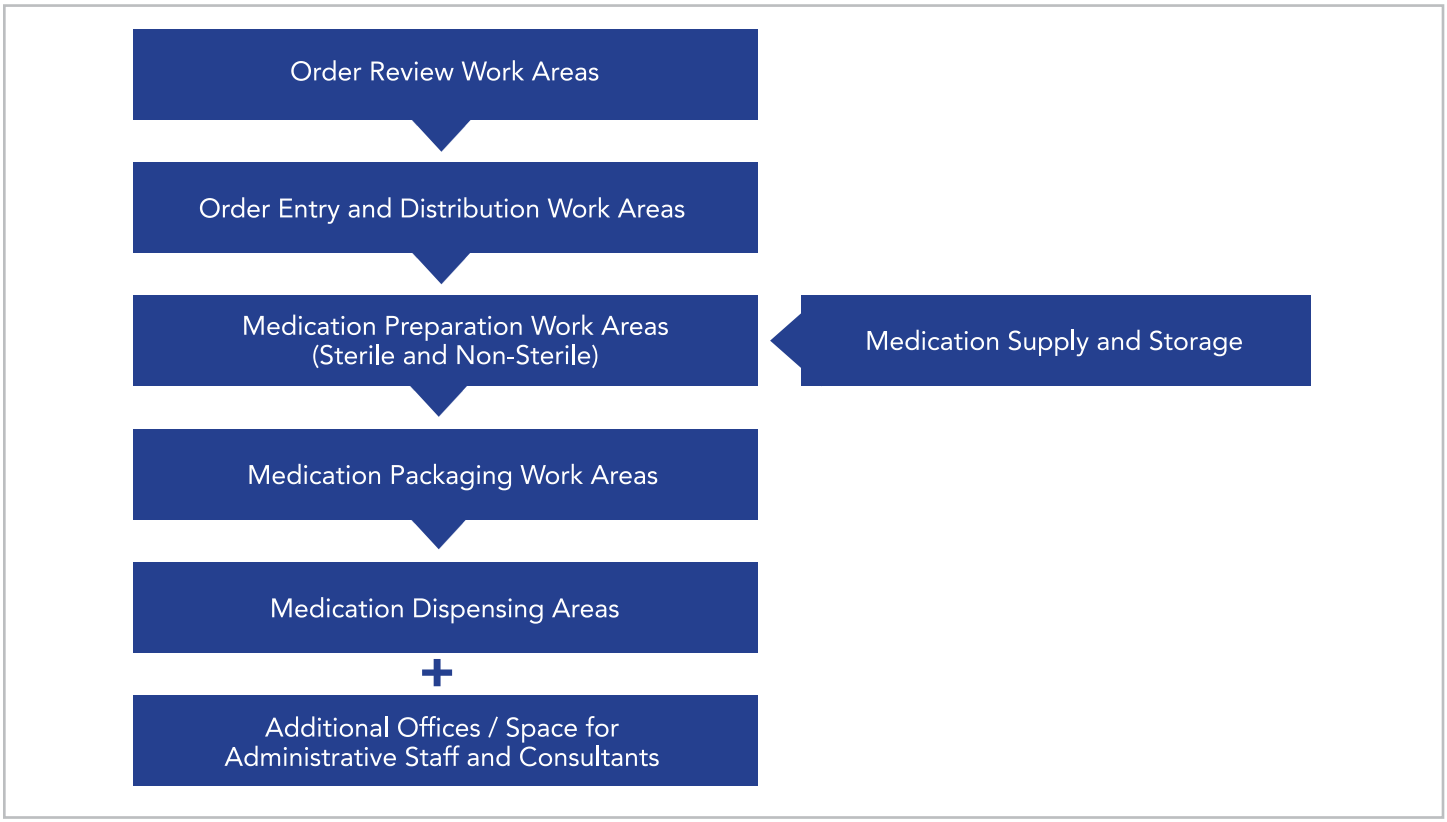
- ***Managing drug products and inventory***, including procuring medications, managing the formulary of available and allowed medications, and securely storing, distributing and disposing of medications.
- ***Preparing medications***, including compounding, packaging and labelling sterile, non-sterile (e.g., lotions) and intravenous (IV) products and mixtures, as well as drugs for clinical trials. Oncology pharmacists play a significant role preparing chemotherapy drugs and mixtures.
- ***Dispensing and delivering medications*** to inpatients and outpatients, either via prescribers or directly. The role of pharmacists is evolving from providing traditional, drug-oriented services to providing more patient-oriented services.[4] In some jurisdictions, pharmacists are taking on direct patient care activities.
- ***Optimizing medication therapies***, including working with the healthcare team to develop the patient's initial care plan, monitoring the patient's compliance and therapeutic response to drugs (e.g. side-effects, allergies), and providing ongoing consultation and advice to prescribers regarding adjustments to the medication regimen. Oncology pharmacists are an important part of the patient care team and contribute highly-specialized knowledge about the medications used for cancer. Pharmacists advise on best practices, appropriate dosages, the formulation of cancer drugs, routes of administration and delivery techniques, therapeutic windows (i.e., the amount of drug that causes the therapeutic effect to the amount that causes toxicity), acute and long-term drug toxicities, the management of cancer and drug-related complications and side-effects, drug interactions and safe handling of hazardous drugs.[5]
- ***Ensuring medication safety***, including testing the quality of the medication stock, reviewing prescriptions and medication orders for appropriateness and accuracy, performing medication reconciliation, and reporting adverse drug reactions and events.
- ***Educating patients and caregivers*** about prescribed medications and how to safely take them. In addition, there is an increased need for patient-centred drug access navigation in both inpatient and outpatient settings. This can be accomplished by hiring dedicated medication reimbursement specialists.[6]
- ***Ensuring the quality of care*** by establishing and using policies and procedures for effective and safe medication use, serving as members of policy-making committees that impact medication use and safety, and regularly evaluating and reporting on the performance of the pharmacy service.

C. RESOURCES

1. FACILITIES AND EQUIPMENT

Pharmacy physical facilities and equipment mirror the pathway outlined in Figure 1, including the following components.

Figure 1: Pharmacy Physical Facilities Pathway



Order review work areas provide space and equipment to assess medication orders for completeness, appropriateness and patient safety. In terms of facility infrastructure, order review requires work areas that are preferably computer-equipped. These areas may be decentralized and do not necessarily need to reside within the pharmacy area. Ideally, orders should be received electronically via software systems that flag missing information and provide alerts when a specialized pharmacy assessment is recommended. This functionality may require specific interfaces for interconnectedness with other associated systems.

In cancer centres, pharmacists – usually specialized in oncology – are included in interprofessional discussions regarding patients. During order review, the pharmacist assesses the chemotherapy order and verifies it from a patient-specific clinical perspective. This includes reviewing the patient's test results, the prescribed drug regimen and doses, the administration method, any additional supportive drugs that have been prescribed and cycle details. If the patient has already had chemotherapy, the pharmacist reviews any history of complications. The pharmacist also verifies the patient identity, performs appropriate safety checks, and discusses any concerns with the oncologist before finalizing the order. See the *Cancerpedia: Chemotherapy* chapter for more information. ***Order entry and distribution work areas*** provide appropriate space and equipment to receive and document approved medication orders. Order entries are then distributed to the appropriate area for preparation. In terms of facility infrastructure, order entry and distribution requires workstations. Ideally these workstations are computer-equipped and software is available that enables verified orders to be entered electronically into a pharmacy information system.

Medication preparation work areas usually include preparation areas for both non-sterile products and mixtures (e.g., lotions) and sterile medications, with biosafety cabinets or laminar flow hoods.

Medication supply and storage is a separate area that feeds into medication preparation work areas. This area must be designed to include appropriate and secure systems for receiving, storing, controlling and disposing of medications.

All physical infrastructure for medication preparation, supply and storage must meet the relevant regulations and requirements of the jurisdiction in which the centre is located. These regulations reflect design standards for occupational health and safety, infection prevention and control, and the safe functioning of the pharmacy, and include:

- The appropriate design and layout of critical areas, including: walls; ceilings; floors; sterile and non-porous work surfaces and counters; hand hygiene stations; emergency eye wash sinks; and lighting
- Personal protective equipment and safe handling processes for preparing, labelling and storing drugs
- Biological safety cabinets, with appropriate venting for the preparation of drugs
- Climate-controlled and ventilated preparation and storage areas, including air handling and exchange systems, and external ventilation
- Electrical systems with emergency power backup
- Fire systems, including special storage for flammable materials
- The safe disposal of waste, hazardous materials and personal protective equipment
- A framework for the traceability of all medications, from the point of entry into the hospital to patient administration (i.e., to aide during product recalls or root cause analysis of patient safety incidents)

See the *Cancerpedia: Physical Facilities and Support Services* and *Cancerpedia: Infection Prevention and Control* chapters for more information.

Medication packaging work areas are where prepared pharmaceuticals are appropriately packaged. These packaging areas should meet similar infrastructure and design standards for occupational health and safety, infection prevention and control, and safe functioning to those identified above. Medication packaging work areas include solid and liquid packaging machines, and must meet sound and hearing protection regulations.

Medication dispensing areas include delivery systems for providing medications to inpatients and outpatients. Medications are not administered in the pharmacy; rather, they are sent to the appropriate location in the hospital, where clinical staff administer medications. Systems to dispense medications must consider the timing and conditions for optimal delivery (e.g., temperature considerations). Medication delivery systems must also include publicly-accessible dispensing areas, with private space for outpatients to pick up medications and receive information.

All medication dispensing systems should include infection prevention and control measures and allow for the secure handling and distribution of medications to patient treatment areas.

Pharmacy facilities usually include ***additional space*** for pharmacy administration staff, and space for staff consultation. Pharmacies should use space outside of secure areas for patient and family consultations.

A large cancer centre will usually have one primary pharmacy site as well as a number of satellite pharmacies that serve particular areas, such as the surgical suites and chemotherapy units. The physical infrastructure of satellite sites should meet all regulatory standards and requirements.

Medication preparation, storage, packaging and dispensing areas should be secure to prevent entry by patients, families or the public. Security measures and systems should meet local regulations and protect staff and medications (e.g., alarm systems, secure entrances and exits, security partitions, secure vaults).

The pharmacy should be located next to, or close to, certain areas. Important adjacencies include units that require convenient, regular access to medications through non-public corridors, such as surgical and perioperative suites, specialized units (e.g., critical care), and certain inpatient and outpatient units. Ideally, areas used for the preparation of chemotherapy and chemotherapy treatment should be directly linked, as is possible with a satellite pharmacy, so as to minimize the impact of spills. The pharmacy should also preferably be close to receiving and loading areas, where medications and supplies are delivered.

The design of the pharmacy service should be flexible, and enable workstations to be reorganized or retrofitted for new technologies and approaches, or to support future expansion. For example, the consideration of robotics for future growth requires appropriate planning for infrastructure, such as weight and space requirements.

Finally, pharmacy physical infrastructure, including equipment, must be in excellent working order. Physical infrastructure must be regularly maintained, upgraded and replaced as necessary.

2. HUMAN RESOURCES

The pharmacy service needs sufficient staff with an appropriate mix of skills to meet the medication needs of

patients. Pharmacy staff include professional and technical personnel working to their full scopes of practice, which may vary depending on the jurisdiction in which they work. Clerical staff provide administrative and other support.

Pharmacists

Pharmacists are experts in medicinal drugs, including their use, function and side-effects. Pharmacists are members of the multidisciplinary/interprofessional care team and work closely with oncologists, nurses and other members of the healthcare team. In the cancer centre, pharmacists assess medication orders (especially for chemotherapy) in terms of the patient's medication and treatment history and recommended treatment protocols. The pharmacist oversees the preparation of medications by the pharmacy technician, verifies that the final order is correct and approves the medication for distribution. After treatment, the pharmacist works with the healthcare team to review the patient's medication needs, complications, side-effects and any options to adjust medications.

With their expert knowledge of cancer medications and side-effects, oncology pharmacists play a key role in educating patients and their caregivers throughout treatment.[7] In some jurisdictions, the clinical pharmacist takes on direct patient care and education activities.[8] Outpatient clinical pharmacists have ever-growing roles in the management of patients, including providing patients with information about their medications and how to take them, advising on preventing or managing side-effects, and remaining available for any medication-related questions the patient may have. This increase in the scope of pharmacy practice is becoming more important as the prevalence of oral chemotherapy regimens increases.[9] In some jurisdictions, the responsibilities of the clinical pharmacist with respect to patient care are decided by the collaborating physician, or health facility or system.[10] Elsewhere, the jurisdiction establishes expected standards for the clinical pharmacist practitioner, who provides drug therapy management under the direction or supervision of a licensed physician.[11]

Pharmacists must have a bachelor's degree in pharmacy, and may also be trained at a master's or doctoral level. All pharmacists should be licensed to practice through a national or subnational regulatory organization, depending on the jurisdiction.[12] Pharmacists working in a cancer centre should have additional training in oncology pharmacy and may also have additional subspecialty training in the use of chemotherapy for cancer patients (e.g., oncology residencies). Cancer centres may require their pharmacists to be formally certified in oncology pharmacy.[13] Oncology pharmacists may be assigned to a specific cancer disease site to advance their specialized knowledge.

Pharmacy Technicians

Pharmacy technicians work closely with pharmacists. Although technicians usually receive final approved orders from the pharmacist, prepare the medications and distribute verified medications, their role varies by jurisdiction.[14,15] In the United Kingdom, pharmacy technicians have a clinical role, which includes providing information to and advising patients about their medications, reviewing medication charts, identifying medication-related problems for follow-up by the pharmacist and participating in discharge planning.[15]

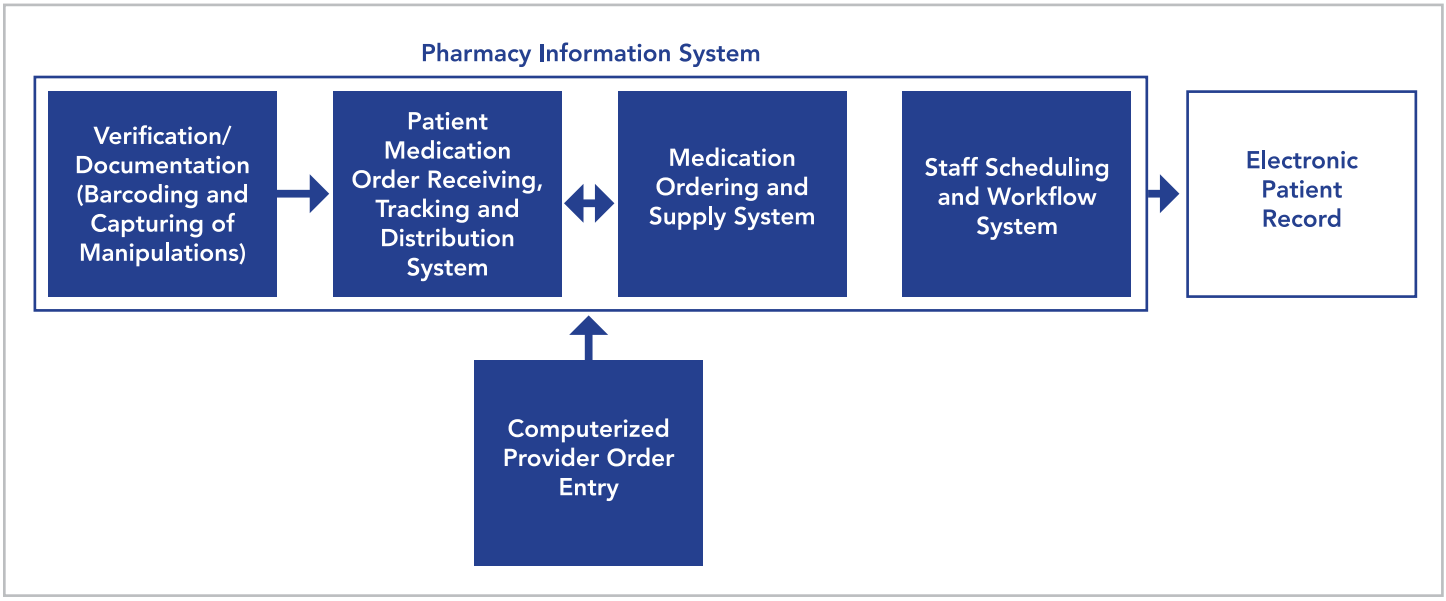
Generally, pharmacy technicians complete a college-level training program and may need additional training or experience in oncology to work in a cancer centre. Depending on the jurisdiction, pharmacy technicians may be regulated, which directly impacts standard education requirements.

3. INFORMATION MANAGEMENT

Ideally, the cancer centre should have a pharmacy information system that captures information relating to medication inventory and supports pharmaceutical care. The pharmacy information system must connect to the corporate-wide information management (IM) infrastructure, which includes the patient health record. Ideally, the corporate-wide IM infrastructure and the pharmacy information system are electronic and fully integrated. If no electronic system is available, procedures for paper documentation must be developed.

A number of major information systems feed into the pharmacy information system, as illustrated in Figure 2.

Figure 2: Information Management Infrastructure for Pharmacy



Verification/documentation (barcoding and capturing of manipulations) systems link the processes and products used for compounding (i.e., drug, syringe, IV bag and diluent) to verify that products have been made correctly and to ensure the traceability of each element to the manufacturer, lot and point of expiry. Documentation capture supports these goals and may include images, videos, gravimetric analysis and barcodes. Institution-specific barcodes may be issued for internally compounded, prepackaged and manufactured products (i.e. to identify groups of products used together to create a single product).

Patient medication order receiving, tracking and distribution systems house patient-specific information about medications ordered electronically using computerized provider order entry (CPOE). CPOE should incorporate clinical decision support tools that aid in the selection of chemotherapy and other medications by assessing patient characteristics in relation to a computerized knowledge base of current best practice standards and guidelines.[16] In addition to documenting received orders (i.e., incomplete and final), the system also tracks the status of the order as it is approved, prepared and verified, and details of the order distribution (i.e., date, time, delivery destination and method). Barcoded medication administration technology may be used to identify and distribute medications.[17] The system also documents what information and education has been provided to the patient related to their medication order. The ideal state is a closed-loop medication system that independently verifies patient-specific prescription to patient-specific administration.

Medication ordering and supply systems document information on medications, equipment and supplies that are currently available in the inventory, as well as those that need to be ordered. These systems also track usage to identify any issues. Medication ordering and supply systems must be linked to the corporate-wide purchasing IM system. These systems should be able to handle requests for back orders.

Staff scheduling and workflow systems ensure that the right staff and services are available and organized appropriately to support the effective and efficient movement of medications and information, from the initial review of orders to the final delivery of medications and information.

D. MANAGEMENT

4. LEADERSHIP

Pharmacy leadership is usually a dyad of clinical and administrative expertise that is overseen by a chief pharmacy officer. A clinical lead (or head pharmacist) and an operational lead (or pharmacy operations director) support the chief pharmacy officer. They work as a team to ensure that competent staff are recruited, developed, supported, and meet best practice and performance standards, and that the pharmacy

service runs effectively, efficiently and safely. Leadership is accountable for the overall quality and safety of the pharmacy service. The clinical lead and operation lead may delegate responsibilities to managers and may establish advisory committees in such areas as treatment guidelines, improvements in drug use, medication management and safety.

5. OPERATING STANDARDS AND GUIDELINES

Pharmacies must meet a wide range of operating standards and guidelines set by various organizations. Generally, accreditation standards and guidelines relevant to pharmacy services address the following broad areas.[18-24]

Services

Accreditation standards and guidelines for the pharmacy service typically include the following requirements:

- Professional pharmacy staff work as a team, with prescribing professionals supporting safe medication management processes and practices (e.g., staff use information and prescribing tools, such as protocols, guidelines and checklists; staff allow access to pharmacy consultations; staff provide education on adverse drug events)
- The cancer centre has a formulary of available medications, and criteria for adding and removing medications from the list
- The cancer centre keeps available medications at a minimum, with processes in place to manage shortages and access medications not on the formulary
- Stringent identification systems are used when labelling, packaging and storing medications
- Standard processes are used to order medications (e.g., required information, communication method, verification, approvals, use of CPOE, preprinted orders)
- Standard and safe practices are used to prepare, dispense and transport medications (i.e., required organizational practices / standard operating procedures relating to: the "do not use list" of abbreviations; medication reconciliation as a strategic priority; medication reconciliation at care transitions; concentrated electrolytes; heparin safety; high-alert medications; infusion pump safety; and narcotic safety)[18]
- Patients and caregivers are educated on how to self-administer medications, identify reactions and prevent errors
- A risk management program is in place to reduce medication-related errors and events

Facilities and Equipment

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

- Meet all planning, design and construction requirements set by subnational, national and international regulatory bodies
- Provide adequate space and a physical layout that ensures good workflow, efficiencies, and infection prevention and control
- Ensure the necessary medications, equipment and supplies are available, in good condition, safe to use and easily accessible

Human Resources

Accreditation standards and guidelines for pharmacy human resources require clinical staff to be fully-qualified, licensed by their regulatory college or association, and able to meet the responsibilities expected of them. Accreditation includes requirements for continuing education, professional development and certifications, as required. Additional 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 pharmacy service. A more specific approach may identify the competencies required of pharmacists and pharmacy technicians, along with the number and mix of staff needed to provide a safe and effective service.

Quality and Patient Safety

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

- A quality improvement plan for the pharmacy service
- Ongoing staff education on quality and safety
- A performance management system that includes collecting data, monitoring indicators and efforts to improve performance
- Safe pharmacy dispensing practices
- Protocols for ongoing safety, such as the handling of hazardous substances and waste, infection prevention and control, and universal precautions

For more information, see the *Cancerpedia: Quality* chapter. For examples of accrediting bodies in healthcare – many of which consider pharmacy services – see the International Society for Quality in Health Care.[24]

6. SUPPLY CHAIN MANAGEMENT

Pharmacy leadership must ensure a robust supply chain for essential drugs. Where appropriate, a centralized process for purchasing medications within a geographic region may decrease costs due to bulk orders. However, it is also important to ensure that multiple suppliers are available, to avoid any disruptions in the However, it is also important to ensure that multiple suppliers are available, to avoid any disruptions in the supply chain. Automated software can prompt a reorder when the medication supply reaches a threshold point.

A process for switching drugs should be documented as a standard operating practice and strictly enforced. This enables a smoother transition and ensures required mechanisms are in place at each institution involved in making the change.

7. DATA-INFORMED MANAGEMENT DECISIONS

Data-informed management decisions require the selection of performance indicators and targets, the collection of data, an assessment of performance in relation to targets, and focused efforts on areas that need improvement. Improvement can be assessed in various ways. For example, the pharmacy service can focus on internal performance improvements, compare its operational and clinical effectiveness in relation to external standards, or compare its operational and clinical effectiveness in relation to external peer group benchmarks. Given that the amount of data collected can be overwhelming, management should develop a minimum data set of clearly-defined key indicators to monitor activities and processes and to improve performance.

Examples of pharmacy indicators that may inform management decisions are depicted in Table 1.

Table 1: Examples of Pharmacy Management Indicators and Management Analysis

Area	Indicators	Management Analysis
Orders	• Number and type of medication orders • Number of medication orders that need to be modified, require additional information or have issues to be resolved • Time the order is received by the pharmacy to when the medication is received by the patient	• Profile of medication orders and analysis of changes over time • Rate and analysis of issues that need resolution and improvement tactics • Rate of pharmacy orders that are incorrectly prepared • Analysis of the time the order is received by the pharmacy to when it is sent to the treatment site, compared to target • Analysis of baseline targets met
Medications	• The number of medications requested not on the formulary • The number of incorrect patients, medications, and administration of dose, route and rate • The number of incidents, including adverse events and near-misses	• Analysis of requested medications not on the formulary over time, to inform modifications to the formulary • Analysis of patient incidents, medications and administration errors, and tactics to address issues • Analysis of incidents and preventative tactics

Patient Consults	• The number of patient, caregiver and family education consultations	• Analysis of education consultations over time, and tactics to meet common information and education needs more effectively • Patient questionnaires and assessment/reinforcement of education over time
Safety Best Practices	• Compliance with verification and safety protocols • Compliance with quality and safety regulations and requirements	• Rate of compliance with verification and safety protocols compared to target, and improvement tactics • Rate of compliance with quality and safety regulations and requirements
Use of Resources	• Volume of drugs, equipment and supplies used in the pharmacy service in relation to activity	• Track volumes, resource utilization and costs (e.g. financial, human, capital, operating), and identify resource gaps and opportunities for improved efficiencies without compromising the pharmacy service • Consider the use of denominators, such as patient days or activities per shift, rather than straight hours or bed number

E. QUALITY

8. STANDARDS, GUIDELINES AND BEST PRACTICES

Pharmacy and oncology standards, guidelines and best practices may originate from different sources, including subnational, national and international organizations and bodies. Although cancer centres may develop local pharmacy best practices, best practices generally align with the national and subnational standards and guidelines of the jurisdiction in which the cancer centre is located.

Professional Human Resources

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

Pharmacy

- Australia: Pharmaceutical Society of Australia;[25] Clinical Oncological Society of Australia[26]
- Canada: Canadian Association of Pharmacy in Oncology;[27] The Pharmacy Examining Board of Canada[28]
- Europe: European Society of Oncology Pharmacy[29]
- International: International Pharmaceutical Federation;[12] The International Society of Oncology Pharmacy Practitioners[19]
- United Kingdom: General Pharmaceutical Council;[30] British Oncology Pharmacy Association[31]
- United States: Board of Pharmacy Specialties;[13] American College of Clinical Pharmacy;[32] American Society of Health-System Pharmacists;[33] Hematology/Oncology Pharmacy Association[34]

Pharmacy Technicians

- Canada: National Association of Pharmacy Regulatory Authorities[35]; Canadian Association of Pharmacy Technicians;[36] The Pharmacy Examining Board of Canada;[28] Canadian Council for Accreditation of Pharmacy Programs[37]
- United Kingdom: General Pharmaceutical Council[30]
- United States: Pharmacy Technician Certification Board[38]

Pharmacy System

Leading organizations have developed standards of practice for oncology pharmacy. Examples include the following:

- The International Society of Oncology Pharmacy Practitioners' Standards of Practice[19]
- The Canadian Association of Pharmacy in Oncology's Standards of Practice for Oncology Pharmacy in Canada[19]
- The American Society of Clinical Oncology/Oncology Nursing Society's Chemotherapy Administration Safety Standards[39,40]

Quality practices for ordering medication and medication safety include the following:

- Consultation between the prescribing professional and the oncology pharmacist
- Evidence and consensus-based treatment guidelines for the use of medications in cancer treatment, which are developed with the involvement of pharmacists and which may be either adopted or adapted from international, national or subnational guidelines, or created by the cancer centre to reflect local best practices
- Computerized systems and standardized tools to guide the selection and ordering of medications and chemotherapies, for example: the CPOE; standard orders for selected drug regimens; preprinted medication orders; and computerized alerts for potential contraindications, drug interactions or excessive dosages
- Standardized patient and drug identification, including standardized formats and terminology and barcoded labels
- A stringent review and verification process for medications (i.e., focusing on 'right drug, right dose, right administration route, right timing, right patient'), usually including continual checks by at least two professional staff from medication order to administration
- A medication reconciliation processes
- An adverse drug reaction reporting system
- Patient information and education

Quality practices to assess incidents and identify improvements include the following:

- An incident process, including a standard written report
- A review process, to assess the incident and identify areas for improvement
- Root cause analysis

The pharmacy service must have a continuous ***quality assurance*** program that identifies areas for improvement and implements beneficial change. The goal of quality assurance is to prevent potential issues from happening and to focus on what can be improved. There should be a focus on efficacy instead of efficiency.

For more information about quality assurance, see the *Cancerpedia: Quality* chapter. For guidelines relating to the clinical management of chemotherapy patients, see the *Cancerpedia: Chemotherapy* chapter.

9. PERFORMANCE MONITORING, REPORTING AND QUALITY IMPROVEMENT

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

Establishing a quality framework to guide performance improvement efforts. The 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.[41] The broad domains should align with the cancer centre's objectives and reflect the particular priorities of the pharmacy service. The selection of broad domains may also be influenced by the external priorities of national or subnational health ministries or organizations that focus on quality in oncology pharmacy. Potential may exist to align efforts with an existing balanced scorecard.

Selecting 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 pharmacy service and may be influenced by the priorities of external bodies. Quality performance indicators should consider structures, processes and outcomes.[42]

Establishing an infrastructure to collect data, monitor and report on performance, and target areas for improvement. The infrastructure includes:

- Information management support to collect, analyze and report on indicators
- A pharmacy performance accountability team to review the indicators in relation to evidence, consensus-based benchmarks and best practice standards and guidelines, establish improvement targets with associated timelines, and track improvements
- Ongoing training for pharmacy staff in quality practices and improvement, including best practices, adverse events (i.e., recognize, respond, report, disclose) and human factors (i.e., elements that can influence people and their behaviour)
- Communication of performance information to promote transparency and drive continuous quality improvement for those working in the pharmacy service and – more broadly – everyone in the cancer centre, including commentary on the data, expected plans of action and reporting on successes

F. THE FUTURE

Cancer medication therapies are evolving into complex drug regimens that target cancer cells as they develop, are personalized to the individual and are used with other therapies. The oncology pharmacy service is a key player in the safe and effective delivery of this increasingly complex combination of agents. Pharmacists will increasingly be called upon to manage concurrent medication therapies through comprehensive medication reviews, medication reconciliations, drug use reviews, the ordering and review of laboratory tests, immunizations, drug dosage adjustments and the identification of gaps in care.[43] In addition, pharmacists will increasingly become engaged in discussions about the cost-benefit of expensive specialty medications.

Not all new therapies are traditional drug-based chemotherapies. As fields such as virology, immunology and stem cell therapies continue to emerge, pharmacies must lead the development of safe handling and storage standards to ensure staff and patient safety are maintained. New therapies will likely add complexity to the system when it comes to the selection of drugs. They will also present a number of new challenges; for example, staff members who have been exposed to viruses can't manipulate those same viruses. Further, biologics represent challenges related to drug costs, as the likelihood of subsequent entry biologics being developed is lower than the likelihood of generic drugs being developed, and the price reduction is not equivalent.

As new drugs are developed, pharmacies will face a significant challenge in managing the costs of implementing new therapies. Demonstrating sterility in a facility-specific study for each new compound is quite expensive. Additional studies may be required to determine the stability of new compounds beyond the information available from the manufacturer, which can also inform the costs associated with wastage. As new drugs are introduced or the volume of drugs increases, facilities must invest in infrastructure to ensure proper storage requirements (e.g., availability of adequate air exchanges).

Business intelligence and data science will become increasingly important as healthcare organizations shift towards data-driven improvements and cost reductions. See the *Cancerpedia: Governance and Management* chapter for more information.

New standards will likely be adopted that change the way drugs are administered. These may include closed system transfer devices, which utilize a valve that eliminates the need to spike the medication bag. The use of closed system transfer devices can also increase sterility beyond vial stability. Closed system transfer devices increase patient and staff safety and are currently used for high-risk drugs.

There is a trend towards the delivery of chemotherapies in settings outside of the cancer centre, such as community hospitals and clinics. To ensure best practices and the quality and safety of care, these sites

should be connected to a larger chemotherapy network that includes the cancer centre. Specialized oncology pharmacists play an important leadership role in assessing the appropriate range of chemotherapy for each setting, as well as delivery standards. They may also be involved in patient treatment plans that impact the continuity of care, provider and patient education, prevention of and response to side-effects and adverse events, quality assurance and follow-up care. Specialized outpatient pharmacists are playing a leadership role in helping to establish safe chemotherapy practices at home. See the *Cancerpedia: Chemotherapy* chapter for more information.

Pharmacy physical facilities will continue to become more mechanized, with automated equipment performing manual tasks. This automation includes computerized dispensing equipment, such as robotics and carousels, and automated delivery systems, such as conveyor systems. This trend will impact the responsibilities of technical staff, who may take on more active quality assurance and patient information roles.

The use of robots will likely increase in the future, as more integrated models with increased dexterity are developed. From a safety perspective, the use of robots improves staff safety by decreasing staff exposure to toxic materials, and improves patient safety through better documentation and tracking. Moving forward, different robots may be established to handle different drugs to avoid any cross-contamination, similar to having different storage spaces and rooms. These robots may also be able to provide increased levels of documentation and verification than what currently exists.

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