

Basics of Systemic Anticancer Therapy Prescribing and Verification

Trinh Pham Joan Rivington

LEARNING OBJECTIVES

Upon completion of the chapter, the reader will be able to:

- 1. Write clear and concise anticancer therapy prescriptions that reduce the risk of errors.
- 2. Effectively review anticancer therapy prescriptions with the recognition of essential elements that should be included in the prescription.
- 3. Identify the components that should be included in a prescription for oral cancer therapy.
- 4. Identify the potential risks for errors with intrathecal drug prescribing, verification, and administration.
- 5. Identify supportive care measures and ancillary drugs that should be considered in anticancer therapy prescriptions.

INTRODUCTION

Over the last decades, systemic anticancer therapy options have expanded and improved significantly, resulting in the development of more complex treatment regimens. Many of the anticancer regimens include traditional cytotoxic chemotherapy in conjunction with biologic, immunologic, and targeted therapy in some combination or sequence to inhibit cancer cell growth at various steps. Because of the complexity of the treatment regimens, the narrow therapeutic window of the anticancer agents, and the potential for serious and fatal consequences of anticancer therapy medication errors, it is essential that oncology practices have in place a systematic approach in prescribing and verifying anticancer therapy that prevents medication errors when providing treatment for cancer patients. The goal of cancer therapy is to ensure the delivery of the right drug in the right dose and dosage form at the right time to the right patient.¹ The achievement of this goal requires establishing and implementing specific policies and procedures for the process of cancer therapy prescribing, verification, dispensing, and administration with the involvement of a multidisciplinary team (physicians, physician assistants, nurses, and pharmacists). The purpose of this chapter is to provide recommendations that ensure safe prescribing, dispensing, and administration of anticancer therapies. Cancer therapy drug administration is provided to patients both in the outpatient and inpatient settings; thus, the recommendations provided in this chapter will refer to both of these settings inclusively as the practice site. The following topics will be addressed in this chapter:

- The role of education and training of oncology healthcare providers
- Anticancer therapy prescribing (role of the prescriber) and verification (role of pharmacists and nurses)
- Strategies to prevent errors in anticancer therapy prescriptions including parenteral, oral, and intrathecal orders
- Precautions with intrathecal anticancer regimens
- Supportive care and ancillary agents for anticancer therapy

ONCOLOGY TRAINING

An unrestricted registered nurse license qualifies a nurse to practice anywhere in the United States; however, individual hospitals and oncology practices may stipulate additional chemotherapy competency requirements in order to practice in an oncology specialty. The Oncology Nursing Society (ONS) offers a chemotherapy and biotherapy program to prepare nurses to administer chemotherapy to patients and fulfills the continuing education requirement of the basic oncology nursing certification exams. The Oncology Nursing Certification Corporation (ONCC) offers the following five certification examinations in the field of oncology: (1) Oncology Certified Nurse (OCN), (2) Certified Pediatric Hematology Oncology Nurse (CPHON), (3) Certified Breast Care Nurse (CBCN), (4) Advanced Oncology Certified Nurse Practitioner (AOCNP), and (5) Advanced Oncology Certified Clinical Nurse Specialist (AOCNS). The certification program allows nurses to gain professional credentials in the field of oncology.

For a pharmacist to become licensed and registered he/she must pass the North American Pharmacist Licensure Examination (NAPLEX) and the Multistate Pharmacy Jurisprudence Exam (MPJE) for the state in which he/she wishes to practice. The license qualifies the pharmacist to practice in all areas of pharmacy; however, residency training in different specialty areas is offered after completion of pharmacy school and attainment of a registered pharmacist license. In oncology, a 1-year oncology specialty residency (postgraduate year 2, PGY2) is available to licensed pharmacists after completion of a general practice pharmacy residency (postgraduate year 1, PGY1). Furthermore, board certification in oncology pharmacy (BCOP) is available for all licensed pharmacists (completion of a residency is not a prerequisite) and is provided by the Board of Pharmacy Specialties. The American College of Clinical Pharmacy, the American Society of Health-System Pharmacists, and the Hematology/Oncology Pharmacy Association provides oncology preparatory and recertification courses, and information about these programs is available at their respective websites. As with nursing, a registered pharmacist license allows the practitioner to practice anywhere in the United States, but certain hospitals and oncology practices may require BCOP or residency training as a stipulation for employment to practice in the oncology specialty area.

For physicians, 3-year oncology and hematology fellowships are offered through many schools of medicine in affiliation with major cancer centers and hospitals to provide clinical and basic research training for MDs or MD/PhDs. Physicians are also eligible for board certification in oncology, hematology, or both through the American Board of Internal Medicine (ABIM). At the time of application for certification in hematology or oncology, the physician has to be previously certified in internal medicine by ABIM; satisfactorily complete the requisite graduate medical education fellowship training; demonstrate clinical competence, procedural skills, and moral and ethical behavior in the clinical setting; hold a valid, unrestricted, and unchallenged license to practice medicine; and pass the hematology or oncology certification examination.

Table 2-1 Recommended Websites for Oncology Education and Oncology Certification Information

Nurses	
Education program	www.ons.org/CNECentral/Chemo
Certification program	www.oncc.org
Pharmacists	
Education programs	www.accp.com/education/oncologyCourses.aspx www.ashp.org/menu/Education/Certifications /OncologyCourse.aspx www.hoparx.org/education/default/bcop-recert.html
Certification program	www.bpsweb.org
Physicians	
Certification program	www.abim.org
Physician Assistants	
Certification program	Currently, no certificate of added qualifications in oncology

A physician assistant (PA) is a graduate of an accredited PA educational program who is nationally certified and state licensed to practice medicine with the direction and responsible supervision of a doctor of medicine or osteopathy. All 50 states and the District of Columbia allow PAs to practice and prescribe medications. Practicing PAs must complete 100 hours of continuing medical education every 2 years. PAs must be authorized by the state (licensed, certified, or registered) before they can begin practice. All the states and the District of Columbia require that applicants meet the following criteria: (1) graduation from an accredited PA program; and (2) passage of the National Commission on Certification of physician assistant Physician Assistant National Certifying Exam (PANCE). Currently, there is no certification with added qualifications in oncology for physician assistants and no formal training requirements for PAs to work in oncology. The majority of PAs specializing in the field of oncology receive training through direct mentorship by their supervising physician and self-study.² There are few postgraduate PA oncology programs available in the United States, and 2 example programs include the MD Anderson Cancer Center Postgraduate PA Program in Oncology and the Mayo Clinic Postgraduate PA Fellowship in Hospital Internal Medicine with an optional hematology/oncology track. See Table 2-1 for websites with oncology training information.

EDUCATION

Knowledge is empowering, and the maintenance of continuing education by healthcare professionals involved in cancer treatment encourages active engagement and critical thinking in the prescribing and assessment of anticancer therapies. Before healthcare professionals are allowed the privilege of prescribing, dispensing, or administering anticancer therapy they should undergo training, certification, and orientation to gain competency to perform these functions. Institutions that treat cancer patients should have a process that confirms staff and trainees have been appropriately educated and are qualified to prescribe, dispense, or administer anticancer therapy. Furthermore, professional continuing education (CE) opportunities should be available, proof of annual completion of CE should be required, and annual reassessment of basic competencies should be performed so that employers can ascertain that healthcare professionals are up to date with their knowledge base of anticancer therapy. Lastly, policies and procedures should be reviewed periodically to ensure that the oncology practice has incorporated technological advances or contemporary information on newly approved anticancer agents to ensure that the healthcare professionals are performing their responsibilities with current information.

Healthcare providers practicing in the field of oncology should be knowledgeable and have current information available about the following aspects of the anticancer therapies:

- 1. The principles involved in treating patients with cancer
- 2. The basics of anticancer therapy:
 - a. Names of the anticancer therapy formulations
 - b. Mechanisms of action
 - c. Appropriate dosages (maximum dose when applicable)
 - d. Routes of administration
 - e. Administration schedules
- 3. Indications for the anticancer therapy, which may be clarified from:
 - a. Food and Drug Administration (FDA) –approved indication
 - b. Standard anticancer therapy protocols commonly used for specific diagnosis
 - c. Data from clinical trials
 - d. Investigational drug protocols
- 4. Preparation, storage, and transportation of anticancer therapy
- 5. Appropriate and safe handling of anticancer therapy

- 6. Potential adverse effects:
 - a. Principles of prevention and management
 - b. Early identification of adverse events
 - c. Ongoing monitoring
- 7. Potential drug interactions

CANCER THERAPY PRESCRIBING

The prescription for an anticancer regimen is initiated by a physician or a nonphysician healthcare provider, such as nurse practitioners or physician assistants, with prescribing privileges. The prescribing of cancer therapy should be restricted to providers with appropriate oncology education and clinical privileges. At least one other medically responsible individual who is knowledgeable about medical oncology should countersign cancer therapy orders prescribed by physicians in training and nonphysician healthcare providers. The verification by the countersigner should include confirmation that the correct treatment is being initiated along with checking the appropriateness of the dose, administration schedule, and any modifications from planned or expected treatment.³ Because of the inherent risk of misinterpretation and circumvention of a checkpoint in the order-verification process, oral communication of cancer therapy prescription orders (verbal orders) by the prescriber should not be permitted by the practice site except to hold or stop anticancer therapy.³⁻⁵

There are many factors involved in choosing the best cancer therapy for a particular patient, and these factors include the patient's cancer diagnosis, stage of the disease, comorbidities, performance status, and organ function. Furthermore, cancer therapy prescribing is a complex process because in addition to standard anticancer regimens for a specific cancer diagnosis, in some instances, the treatment regimens may be derived from preliminary research reports (published abstracts), published studies, and clinical trials. In these instances the indications, dosages, and administration schedules may differ amongst the varying publications or from FDA-approved product labeling. Thus, in prescribing cancer therapy, it is crucial that the chosen treatment regimen is clearly communicated to the patient and all members of the healthcare team to prevent medication errors and ensure safe preparation, dispensing, and administration of the anticancer drugs. Documentation of the cancer therapy prescription should include why a regimen was chosen for a patient, and a reference source for the chosen regimen should be readily available. When a patient's treatment deviates from the standard of care or a referenced source, the rationale for the change should be

documented to facilitate the verification process and prevent misinterpretation of the prescribed regimen by other members of the healthcare team. The following section provides recommendations on factors to consider and policies to implement to ensure safe treatment of cancer patients.

Computerized Provider-Order-Entry for Anticancer Agents

In order to prevent anticancer therapy errors, the American Society of Clinical Oncology/Oncology Nursing Society Chemotherapy Administration Safety Standards Including Standards for the Safe Administration and Management of Oral Chemotherapy recommend that practice sites maintain and use standardized, regimenlevel, preprinted or electronic forms for all parenteral anticancer prescription writing.⁴ Standardized forms simplify and expedite anticancer prescribing because well-designed, organized forms prompt prescribers to approach anticancer therapy in a clear, consistent, and uniform manner and reduce errors that may occur in the transcription process. The standardized forms should contain information such as the following:

- The patient's name and unique identifying number (date of birth or medical record number)
- The date the order was written
- The diagnosis
- The regimen name and cycle number
- Protocol name and number (if applicable)
- Appropriate criteria to treat (eg, based on relevant laboratory results and toxicities)
- Allergies
- Reference to the methodology of dose calculation or standard practice equations (eg, calculation of creatinine clearance)
- · Height, weight, and any other variables used to calculate the dose
- Dosage (doses do not include trailing zeros; use a leading zero for doses less than 1 mg [eg, 0.5 mg])
- Route and rate (if applicable) of administration
- Length of infusion (if applicable)
- Supportive care treatments appropriate for the regimen (including premedications, hydration, growth factors, and hypersensitivity medications)
- Sequence of administration (if applicable).⁴

Additional information that may be helpful includes the date and time the treatments are to be administered, patient-specific laboratory values from which

the dosage is calculated, and lastly, the prescriber's name, signature, and contact information. These standardized forms may be incorporated into e-prescribing software or electronic health records.⁴ If available, computerized provider-order entry (CPOE) provides the same safety and convenience features as preprinted, standardized order forms with additional advantages such as eliminating illegible and incomplete orders, ensuring completeness in prescribing fields, and facilitating efficient prescription order processing through simultaneous, instantaneous transmission of the prescription order to various members of the healthcare team, such as pharmacy or nursing, or to geographically distant sites.⁶ In addition to medication prescribing, CPOE systems may include other built-in functions such as diagnostic test ordering along with clinician alerts to prevent errors and to assist with adherence to current clinical practice guidelines.

A discussion on the process of implementing a CPOE system is beyond the scope of this chapter. The following readings are recommended for a thorough review on CPOE: ASHP Guidelines on Pharmacy Planning for Implementation of Computerized Provider-Order-Entry Systems in Hospitals and Health Systems; A Consensus Statement on Considerations for a Successful CPOE Implementation; and CPOE Configuration to Reduce Medication Errors: A Literature Review on the Safety of CPOE Systems and Design Recommendations.⁶⁻⁸

Strategies to Prevent Errors in Cancer Therapy Prescribing

Application of some practical strategies in writing cancer therapy prescriptions can prevent medication errors. When cancer therapy drugs are ordered, the full name of the drug should be used, and the generic name is preferred over brand names, nicknames, or abbreviations. The exception to this rule may apply in instances when there is potential for confusion between different formulations of the same drug.⁵ The *ASCO/ONS Chemotherapy Administration Safety Standards* recommend that all medications within cancer therapy order sets and prescriptions are listed using full generic names and follow Joint Commission standards regarding abbreviations.⁴ The standards further state that brand names should be included with the generic name only in orders where there are multiple products or including the brand name otherwise assists in identifying a unique drug formulation.⁴ See **Clinical Pearl 2-1**.

In the field of oncology, the use of acronyms and abbreviations to designate cancer therapy regimens is pervasive (**Table 2-2**). However, because of the possibility of confusion and misinterpretation, this practice is not recommended when prescribing systemic anticancer therapy or for clinical documentation.³

Cancer therapy orders should inclusively list all chemotherapy agents in the regimen and their individual dosing parameters.⁴ When writing the frequency of administration of a cancer regimen, abbreviations should not be used (eg, write *daily*, not *QD* or *every other day*, not *QOD*, because this may be mistaken as *QID* and patients may receive 4 doses a day instead of the intended once daily or every other day schedule).

CLINICAL PEARL 2-1 Abbreviations, Brand Name, Class Name, or Chemical Name

Some examples of when errors may occur when abbreviations, brand names, or nicknames are used:

- Does Paraplatin refer to cisplatin or carboplatin?
- Does CDDP refer to carboplatin or cisplatin?
- Does CPT-11 refer to cisplatin or irinotecan?
- Does **Taxol** refer to paclitaxel or docetaxel?
- Does vinca alkaloid refer to vincristine, vinblastine, or vinorelbine?
- Does **anthracycline** refer to doxorubicin, daunorubicin, idarubicin, or epirubicin?
- Adria (doxorubicin) may be misunderstood for Aredia (pamidronate)
- **G-CSF** is the abbreviation for "granulocyte colony-stimulating factor"
 - Filgrastim and pegfilgrastim are both **G-CSF** products with different doses and schedules
 - Filgrastim (**Neupogen**) is a short-acting agent and is administered on a daily basis
 - Pegfilgrastim (**Neulasta**) is a long-acting agent and is dosed only once per cycle of cancer therapy
 - The use of the abbreviation *G-CSF* should be avoided because of ambiguity of which CSF is indicated, filgrastim or pegfilgrastim.
 - The generic name or brand name should be used to avoid confusion and ensure that the intended, ordered drug is dispensed and administered.

Exceptions to the Rule—When Brand Name May Be More Appropriate

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- Abraxane is the trade name for *paclitaxel protein-bound particles for injectable suspension (albumin bound)*
 - The dose for conventional paclitaxel and **Abraxane** is not the same.
 - Using the generic name, *albumin-bound paclitaxel*, may lead to the conventional paclitaxel being erroneously dispensed or administered instead of **Abraxane** or vice versa.
 - Add the trade name **Abraxane** to the generic name, *albuminbound paclitaxel*, in prescription orders to ensure that the correct drug is dispensed.
- Doxil is the trade name for liposomal doxorubicin
 - The dose for conventional doxorubicin and **Doxil** is not the same.
 - Using the generic name, *liposomal doxorubicin*, to order **Doxil** may lead to the conventional doxorubicin being erroneously dispensed.
 - Add the trade name **Doxil** to the generic name, *liposomal doxorubicin*, in prescription orders to ensure that the correct drug is dispensed.
- Kadcyla is the trade name for *ado-trastuzumab emtansine*.
 - The dose for trastuzumab (Herceptin) and **Kadcyla** is not the same.
 - Using the generic name for *ado-trastuzumab emtansine* to order **Kadcyla** may lead to trastuzumab (Herceptin) erroneously being dispensed.
 - Add the trade name **Kadcyla** to the generic name, *ado-trastuzumab emtansine*, in prescription orders to ensure that the correct drug is dispensed.

Abbreviation	Generic Name
Anti-CD20	Rituximab
Ara-C	Cytarabine
BCNU	Carmustine
C-225	Cetuximab
CDDP	Cisplatin
CPT-11	Irinotecan
ESA	Erythropoiesis-stimulating agents • Epoetin (Procrit, Epogen) • Darbepoetin (Aranesp)
5-FU	Fluorouracil
Folinic acid	Calcium leucovorin
G-CSF	Granulocyte colony-stimulating factor • Filgrastim (Neupogen) • Pegfilgrastim (Neulasta)
MTX	Methotrexate
VCR	Vincristine
VP-16	Etoposide

Table 2-2 Abbr	eviations for	Commonly U	Jsed Anticancer	Regimens
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Abbreviation	Regimen	Disease
ABVD	Adriamycin (doxorubicin) Bleomycin Vinblastine Dacarbazine	Hodgkin's lymphoma
BEACOPP	Bleomycin Etoposide Adriamycin (doxorubicin) Cyclophosphamide Oncovin (vincristine) Procarbazine Prednisone	Hodgkin's lymphoma (continues)

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Table 2-2 Abbreviations for Commonly Used Anticancer Regimens (continued) (continued)

Abbreviation	Regimen	Disease
R-CHOP	Rituximab Cyclophosphamide Hydroxydaunorubicin (another name for doxorubicin) Oncovin (vincristine) Prednisone	Non-Hodgkin's lymphoma Note: R-CHOP: every 21 days R-CHOP-14: every 14 days
CVP	Cyclophosphamide Vincristine Prednisone	Non-Hodgkin's lymphoma
R-FCM	Rituximab Fludarabine Cyclophosphamide Mitoxantrone	Non-Hodgkin's lymphoma
EPOCH	Etoposide Prednisone Oncovin (vincristine) Cyclophosphamide Hydroxydaunorubicin (another name for doxorubicin)	Non-Hodgkin's lymphoma
AC-T	Adriamycin (doxorubicin) Cyclophosphamide Taxol (paclitaxel)	Breast cancer
TAC	Taxotere (docetaxel) Adriamycin (doxorubicin) Cyclophosphamide	Breast cancer
ТС	Taxotere (docetaxel) Cyclophosphamide	Breast cancer
MVAC	Methotrexate Vinblastine Adriamycin (doxorubicin) Cisplatin	Bladder cancer
EOX	Epirubicin Oxaliplatin Xeloda (capecitabine)	Gastric cancer
ECF	Epirubicin Cisplatin Fluorouracil	Gastric cancer

FOLFOX	Folinic acid (leucovorin) Fluorouracil Oxaliplatin	Colorectal cancer
FOLFIRI	Folinic acid (leucovorin) Fluorouracil Irinotecan	Colorectal cancer
FOLFIRINOX	Folinic acid (leucovorin) Fluorouracil Irinotecan Oxaliplatin	Pancreatic cancer
7+3	Cytarabine for 7 days Idarubicin or daunorubicin for 3 days	Acute myelogenous leukemia
HDAC	High-dose Ara-C (cytarabine, cytosine arabinoside)	Acute myelogenous leukemia

The Prescribing Vocabulary–Anticancer Therapy Regimen Cycle

A cycle of an anticancer regimen is a period of treatment followed by a period of rest before the treatment is repeated again. There are 3 factors to consider in a cycle—the duration, frequency, and number of cycles. The duration is the number of days the anticancer agents are administered within a cycle. The frequency refers to when the cycle is repeated, such as every 7, 14, 21, or 28 days. The number of cycles refers to the length of therapy from start to finish; for example, this may be 4 to 6 cycles for the treatment of breast cancer. When numbering treatment days, day 1 typically describes the day treatment commences. For hematopoietic progenitor-cell transplantation regimens, day 0 refers to the day stem cells are infused and anticancer therapy is typically administered prior to day 0 and is preceded by a negative sign (see **Clinical Pearl 2-2**).

Within a cycle of an anticancer regimen it is critical to write prescriptions for intended daily dose instead of total dose over a period of time to minimize the possibility of error. For example, the order, *cisplatin 100 mg/m² over 4 days*, is ambiguous, may lead to overdosing error, and cause severe toxicity or fatality. The intention of the order is to administer 25 mg/m² daily for 4 days (total of 100 mg/m² for the cycle). As written, the order may be misinterpreted, dispensed, and administered as 100 mg/m² daily for 4 days (total of 400 mg/m² for the cycle). To avoid errors, anticancer therapy prescriptions should be written with the specified dose per meter squared for *each* day instead of the total dose for the cycle. The route, rate, and duration of administration should also be indicated. Healthcare

CLINICAL PEARL 2-2 Numbering of Treatment Days of High Dose Cancer Therapy with Stem Cell Transplant

The labeling of the days of treatment for a high-dose <u>B</u>CNU (carmustine), <u>e</u>toposide, <u>A</u>ra-c, <u>m</u>elphalan (BEAM) regimen for autologous peripheral stem cell transplant is shown below. The days prior to stem cell transplant are referred to as negative days and the days post-stem cell transplant are positive days.

Day	Day	Day	Day	Day	Day	Day	Day	Day
-6	-5	-4	-3	-2	-1	0	+1	+2
BCNU	Etoposide Ara-C	Etoposide Ara-C	Etoposide Ara-C	Ara-C	Melphalan	Stem cell infusion		

providers involved with anticancer drug therapy should be aware of the usual maximum dose limits for individual agents per dose and cycle along with the maximum lifetime cumulative dose for specific agents (eg, anthracyclines and bleomycin). Additionally, when communicating dosing schedules, a dash mark should not be used (eg, day 1 *through* 8 or day 1 *and* 8 should be used; *not* days 1-8). Thus, to minimize the risk of errors, the correct order for a patient with a BSA of 2 m² should read, "cisplatin IV 25 mg/m²/day (dose = 50 mg) in 500 mL 0.9% sodium chloride injection to run over 2 hours day 1 through 4. Start on 4/1/2013."

Care should also be taken to distinguish the same protocol with different cycle frequency such as CHOP (cyclophosphamide, hydroxydaunorubicin [doxorubicin], Oncovin [vincristine], prednisone) versus CHOP14, where CHOP is administered every 21 days and CHOP14 is administered every 14 days.

Dose Calculation

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A priori, the institution/clinical practice should establish criteria for whether a dose should be routinely calculated based on ideal body weight, adjusted body weight, or actual body weight, and which equation will be used to calculate body surface area (BSA) for dosing (refer to the *Dosing Calculations* chapter elsewhere in this text). When the dose of an anticancer agent is calculated based on a weight different from established criteria, the prescription order should indicate which weight was used in calculating drug dosages.³ If the dose or administration schedule of an anticancer agent is modified due to a specific toxicity or organ

pathology, the cancer therapy prescription should explicitly indicate the factor that prompted the treatment modification.³ It is essential to note that doses for anticancer agents can vary tremendously for different disease states or even the same tumor type that is treated by different protocols, and this difference in dosing is a potential source of medication errors (**Clinical Pearl 2-3**).⁹ This emphasizes the need for clear documentation and reference citation of the prescribed regimen against which the order will be verified. Finally, all doses should be calculated independently by the prescriber who writes the order, the pharmacist who prepares the drug, and the nurse who administers it.¹

CLINICAL PEARL 2-3 Variations in Dosing of Anticancer Drugs

Metastatic Colorectal Cancer

There are many variations of the FOLFOX regimen for the adjuvant treatment of colorectal cancer. Clinicians should be aware of these differences since the dosing and schedule of administration is different depending on the regimen. Furthermore, when writing prescription orders for these regimens, the clinician should document the specific regimen that is intended for the patient and the reference source. The FOLFOX4 and FOLFOX6 regimens that follow are only 2 examples of many possible variations for this specific regimen.

FOLFOX4

Leucovorin 200 mg/m 2 IV over 2 hours before fluorouracil, day 1 and 2

Fluorouracil 400 mg/m 2 IV bolus and then 600 mg/m $^2/day$ IV over 22 hours, day 1 and 2

Oxaliplatin 85 mg/m² IV day 1

Every 2 weeks \times 12 cycles

FOLFOX6

Leucovorin 400 mg/m² IV over 2 hours before fluorouracil day 1 Fluorouracil 400 mg/m² IV bolus day 1 followed by 2400 mg/m² /dose IV over 46 hours

Oxaliplatin 100 mg/m² in 500 mL dextrose 5% IV over 2 hours day 1 Every 2 weeks \times 12 cycles

Once the dose of an anticancer agent has been calculated, excessive attempt at precision in dose ordering should be avoided, and doses greater than 5 mg should be rounded to the nearest integer or nearest reasonable amount. For example, for oxaliplatin, write for a dose of 130 mg when the calculated dose is 127.5 mg; or write for a dose of 525 mg for a calculated dose of 521.6 mg for fluorouracil.⁵ Consider rounding to certain percentage changes from the actual calculated dose. For instance, policies and procedures from the institution may allow rounding between 5% and 10% to allow dosing that can be more accurately measured. There is a lack of data regarding appropriateness of dose rounding, but clinically, many institutions allow rounding within this range. Additionally, whether the therapy is curative or noncurative may help to guide dose rounding. Use a leading zero, *not* a leading decimal, when the dose is *less* than 1 mg or 1 g (eg, write *0.1 mg* to prevent reading .1 mg as 1 mg). *Do not* use a trailing zero when writing orders (eg, write *10 mg*, not *10.0 mg* to prevent misinterpretation as 100 mg).^{3–5}

References

Orders for noninvestigational anticancer medications should be verified against published standards (eg, published primary reference in professional journals or meeting proceedings, validated standard reference texts, investigational drug treatment protocol). In order for nonprescribing personnel to be able to independently verify the prescriber's orders for a cancer therapy, all members of the healthcare team should have access to complete, up-to-date copies of published articles for a referenced regimen, validated reference texts for standard anticancer therapy regimens by diagnosis, institutional review board– (IRB-) approved clinical research protocols or guidelines for investigational studies, and drug information references.^{3,4} When a primary reference is not available for verification of a cancer therapy regimen, 2 alternative publications, such as a tertiary reference (textbook) and secondary reference (review article), may be used. Two alternative references are recommended because of the possibility of errors that may occur in the publication process.

Investigational Anticancer Regimens or Medications

Cancer patients often receive investigational anticancer agents as part of their treatment. Institutions that have an active cancer clinical trials program should apply the same safety precautions for the prescribing, verifying, preparing, and administration of investigational cancer regimens/agents as for standard FDA-approved agents. Prior to the implementation of a new IRB-approved investigational study protocol, all healthcare professionals involved should receive protocol-specific information through an educational in-service and an up-to-date copy of the protocol should be readily available for review by all involved with the study protocol. A more in-depth discussion on the policies and procedures related to management and maintenance of an investigational drug service is discussed in the *Investigational Drugs* chapter, elsewhere in this text.

CANCER THERAPY VERIFICATION

The process of cancer therapy verification requires the pharmacist and nurse to independently double check the original anticancer therapy regimen written by the prescriber against published standards. The prescribed anticancer therapy regimen should be evaluated for completeness, agreement with the planned regimen, and deviations from previous treatments for repeated cycles of the regimen. A checklist of the verification process is included in Table 2-3 and potential sources of errors are illustrated in Clinical Pearl 2-4.^{3,4,10} For other potential sources of errors, see the Drug Safety and Risk Management chapter, elsewhere in this text. The practice site should establish guidelines for the frequency of obtaining a patient's weight and specifications for when a dose should be adjusted based on the percentage of weight fluctuation. The anticancer therapy treatment plan should also indicate regimen-specific laboratory tests, including the time interval, to obtain based upon existing evidence-based national guidelines (eg, the American Society of Clinical Oncology [ASCO], the National Comprehensive Cancer Network [NCNN], and the Children's Oncology Group [COG]). When no evidence-based guideline exists, the practice site should determine best practice for its specific institution.^{3,4} There are multiple risk points in the process of anticancer therapy prescribing, verification, dispensing, and administration. The implementation of a double checking policy serves as a safeguard to ensure accuracy and appropriateness of an anticancer regimen prior to completion of the prescription order for dispensing and administration. At the prescribing level, double checking occurs when a second prescriber countersigns a prescription that is written by a physician in training or a nonphysician healthcare provider. The pharmacy double checks by verifying that the regimen is accurate against an appropriate reference, then the anticancer agents are reviewed another time against the original order after the drugs are compounded and prior to dispensing. At the drug administration level, the anticancer regimen is first verified by a nurse against an appropriate reference, then the anticancer regimen is checked one more time against the original order by 2 nurses prior to administration of the drug. Overall, the anticancer prescription is verified at many levels by multiple healthcare professionals providing different types of healthcare services with the goal of maintaining patient safety.

Table 2-3 Checklist for Cancer Therapy Prescribing and Verification^{3,4}

- 1. Confirm that the prescriber is authorized to prescribe systemic anticancer therapy as per the practice site's policies, procedures, and/or guidelines
- 2. Confirm the patient's full name and second patient identifier (eg, medical record number, date of birth)
- 3. Confirm the patient's cancer diagnosis and stage of the disease from the medical records
- 4. Confirm the date and time the order is written
- 5. Confirm the date the anticancer regimen is to be administered
- 6. When indicated, obtain finance approval prior to preparation, dispensing, or administration of the cancer therapy regimen
- 7. Verify the cancer therapy regimen against validated reference text for standard regimens, IRB-approved research protocols for investigation regimens, or primary literature for nonstandard regimens
- 8. Verify that the regimen is appropriate based on:
 - a. Patient's diagnosis (including pharmacogenomics if applicable)
 - b. Performance status
 - c. Organ function status
 - d. Chemotherapy history and, if applicable, radiation therapy history
 - e. Goal of therapy (prevention, improvement in time to progression, prolong survival, cure, palliation)
 - f. Response to last cycle
- 9. On the first cycle, confirm that the ordered cancer therapy is the intended treatment regimen for the patient as documented in the medical records
- For subsequent cycles, the date the patient was last treated and the next planned treatment date should be compared to ensure that it is the appropriate scheduled time for the next dose (ie, current cycle and day)

- 11. Check for allergies, drug hypersensitivity reactions, drug sensitivity
- 12. Check for a complete medication history to assess for potential drug-drug interactions with the planned cancer therapy regimen
 - a. The medication history should include over-the counter, complementary, and alternative medications
- 13. Review the patient's complete medical history and physical examination data from the medical records. At a minimum, the following information should be obtained and the data should be checked for accuracy in measurement and calculation:
 - a. Age, height, weight, body surface area (BSA), performance status (PS)
 - i. Height and weight should be remeasured, BSA recalculated, and PS reassessed as indicated to determine if dosage modification is necessary when there is significant difference with baseline measurements
 - b. Assessment of organ-specific organ function (renal, hepatic, cardiac, pulmonary, etc.) and bone marrow function as appropriate for the planned regimen
 - i. If abnormal laboratory values or organ dysfunction is present, primary references or standard references should be consulted to determine if the abnormality is within acceptable ranges for treatment continuation or if treatment modification is indicated
- 14. Check for accuracy of dose calculation and correctness of dose unit, frequency, number of doses, and scheduled days of therapy
- 15. If the dose is different from the referenced protocol, check for the reason for the dose adjustment and ensure the reason is documented (eg, renal or hepatic dysfunction, experienced toxicities)
- 16. Check maximum individual dose as appropriate (eg, 2 mg for vincristine)
- 17. Check cumulative dose as indicated (eg, lifetime dose limit for bleomycin, doxorubicin)
- 18. Check route of administration (and rate if applicable) is appropriate
- 19. Check that supportive care is prescribed and it is appropriate for the patient and regimen
- 20. Sign and date the prescription as a record of verification. Digital signature/record is sufficient for electronic prescribing systems

CLINICAL PEARL 2-4 Potential Sources of Errors in Anticancer Therapy Prescriptions

Incorrect Name

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Two different identifiers should be used to identify a patient (name *and* birthdate or medical record number).

Example: A father and son with the same name are being treated for different cancers at the same institution. The use of 2 identifiers can avoid a mix-up in prescribing, dispensing, and administration of chemotherapy regimens.

Incorrect Height and Weight

Example 1: A person is weighed in pounds but the information was documented as kilograms. A child weighing 80 pounds had information recorded as 80 kg (about 175 pounds), resulting in a possible 2-fold overdose.

Example 2: Failure to update height information and unfamiliarity with the metric system may lead to errors. If the height for a 16-yearold has not been updated since she was 4 years old in the chart and was recorded as 109 cm, using this data to calculate the body surface area for dosing would result in underdosing. This is because 109 cm equals to 3 feet and 7 inches (1 inch = 2.54 cm), which would be obviously incorrect for a normal 16-year-old.

ORAL ANTICANCER THERAPY

Oral anticancer therapy is an emerging option for the treatment of cancer in selected patients and disease states, and it is expected that the use of oral anticancer therapy and the number of available oral anticancer agents will continue to expand.¹¹ Oral anticancer therapy has the same potential for error and harmful side effects as with anticancer therapy administered by the parenteral route. **Table 2-4** outlines information that a complete prescription for oral anticancer therapy should include as recommended by the *ASCO/ONS Chemotherapy Administration Safety Standards Including Standards for the Safe*

Table 2-4 Information That Should Be Included in a Prescription for OralChemotherapy

- 1. Patient's full name and second identifier (eg, date of birth)
- 2. Prescriber's name
- 3. Date
- 4. Diagnosis^a
- 5. Allergies^a
- 6. Drug name
- 7. Dosage^b and quantity
- 8. Route and frequency of administration
- 9. Administration instructions
- 10. Duration of therapy (days of rest, if applicable)
- 11. Number of refills (if applicable)
- 12. Reference to methodology of dose calculation, height, weight, and other applicable variables

^b Doses may be rounded to the nearest tablet size or specify alternating doses each day to obtain the correct overall dosage. Do not include trailing zeros and use a leading zero for doses less than 1 mg.

Administration and Management of Oral Chemotherapy.⁴ Patients should also receive education regarding their anticancer agents, and information should include side effects to expect and what side effects may require immediate suspension of therapy and seeking medical attention, how to take the medication with regards to meals, the plan for management of missed doses, instructions regarding any associated supportive care medications or measures, possible drug–drug or drug–food interactions, safe handling, storage, and disposal. Refer to the chapter titled Oral Cancer Therapy, elsewhere in this text, for more in-depth discussion.

^a Although not listed in the ASCO/ONS guidelines as a requirement, this information may be useful for clinicians dispensing or administering the medications.

INTRATHECAL ANTICANCER THERAPY

In oncology, intrathecal anticancer therapy is used to treat cancers that have reached the central nervous system, including some types of leukemia and lymphoma. The anticancer agents are delivered into the cerebrospinal fluid (CSF) by injection into the subarachnoid space of the spinal cord (lumbar puncture or spinal tap) or through an Ommaya reservoir (a soft plastic dome attached to a catheter, the tip of which sits in the lateral ventricle) that is placed subcutaneously under the scalp.¹² Safe prescribing and administration of intrathecal anticancer agents involves education of all staff involved with intrathecal anticancer therapy along with implementation of policies and procedures that describes the role of all involved healthcare professionals and delineation of procedures to follow when intrathecal anticancer therapy is administered to patients.

Anticancer Agents for Intrathecal Administration and Dosing Considerations

Only a few anticancer agents are used for intrathecal administration. The 2 most commonly prescribed agents are methotrexate and cytarabine, either alone or in combination with hydrocortisone.¹² Cytarabine is available in 2 formulations—standard cytarabine and slow-release liposomal cytarabine, which produces prolonged cytarabine CSF exposure up to 40 times that of standard cytarabine.¹³ Thiotepa, dexamethasone, or methylprednisolone are less commonly prescribed agents for intrathecal administration.

The dose of intrathecal anticancer therapy and the volume for administration are important factors for consideration. The dosing of intrathecal anticancer therapy is based on age because there is not a correlation between CSF volume and BSA; meaning, there is not a consistent relationship between drug dose and CSF concentration if the dose is based on BSA.^{12,14} The CSF volume of children after the first 3 years of age is equivalent to the CSF volume of adults because CSF volume of an infant increases more rapidly than its BSA.¹⁴ **Table 2-5** provides common doses for intrathecal anticancer agents based on patient age.^{12,14–17} The volume of drug for intrathecal administration should always be of the most minimal volume to avoid increase in intracranial pressure and compromise patient safety. The maximum volume for intrathecal administration is 10 mL; however, in practice, the preferred volume is 5 mL because prior to installation of the intrathecal drug, the same volume of CSF has to be removed as the amount of fluid that will be administered intrathecally. For the Ommaya reservoir, a volume of 3–5 mL of anticancer drug is instilled followed by 5 mL of preservative-free

	Patient A	ge ('	Years)			
Anticancer Agent	< 1	1	> 2	≥ 3–9	≥ 10	Adult
Methotrexate dose (mg)	6	8	10	12	15	10–15 mg/m ² 15 mg
Cytarabine (mg)	12	16	20	24	30	30 mg/m^2
Hydrocortisone (mg)	No Data	8	10	12	12	15–25 mg
Liposome cytarabine dose (mg)	20	25	35	35	35–50	50

Table 2-5 Common Intrathecal Anticancer Therapy Dosing^{12,14–16}

normal saline to flush the drug through the reservoir and into the lateral ventricle. It is also important to note that all drugs for intrathecal administration should be *preservative free* to prevent the risk of inflammatory reactions resulting in effects such as arachnoiditis and sterile meningitis.

Avoid Intrathecal Vincristine Injection

Oncology healthcare professionals should be aware of the catastrophic consequences of accidental administration of intrathecal vincristine. Deaths have occurred worldwide due to the inadvertent administration of vincristine via the intrathecal route; thus, it is essential that appropriate precautions are taken when prescribing, dispensing, and administering vincristine to prevent fatal errors.¹⁸⁻²¹ Unintentional intrathecal vincristine administration occurs when a syringe containing vincristine is mistaken as either methotrexate or cytarabine for intrathecal administration. Mistakes may also occur when a syringe of vincristine is placed in proximity to a syringe containing intrathecal anticancer drugs and the healthcare provider picks up vincristine after incorrectly assuming that it is an additional intrathecal drug. Other reasons for error include mislabeling, unfamiliarity with anticancer therapy, and failure to check medication orders. To avoid inadvertent intrathecal vincristine administration, the United States Pharmacopeial Convention recommends that the dispensed vincristine must be enclosed in an overwrap bearing the statement "Do Not Remove Covering Until Moment of Injection. • For Intravenous Use Only-Fatal If Given By Other Routes•."22 There are recommendations from the Joint Commission that vincristine should be diluted for intravenous infusion in a minibag that would preclude administration via the intrathecal route with a syringe.²³ When intrathecal anticancer agents are prescribed, it should be ordered separately from IV anticancer therapy; furthermore, intrathecal drugs should be packaged and transported immediately before administration. Intrathecal medications should also be separate from other IV drugs and should not be stored in a patient care area.²³

SUPPORTIVE CARE AND ANCILLARY MEDICATIONS

An anticancer therapy prescription is not complete without supplemental orders for ancillary medications that prevent or alleviate side effects. Without the proper supportive care orders, patients may not be able to tolerate or complete their anticancer therapy. Supportive medications are divided into the following categories: premedications to prevent infusion-related or hypersensitivity reactions and medications to prevent side effects such as nausea and vomiting, febrile neutropenia, tumor lysis syndrome, and nephrotoxicity. **Table 2-6** provides a checklist to ensure that appropriate supportive care medications are considered, and **Table 2-7** lists the recommendations for prevention of nephrotoxicity associated with anticancer therapy.^{24–26} An in-depth discussion for each of these supportive care issues is beyond the scope of this chapter; however, recommended readings for each of these topics are listed in the *Suggested Reading* section at the end of this chapter.

Table 2-6 Checklist of Ancillary Medications to Consider

- Are premedications indicated?
- Is there a need for IV hydration to prevent nephrotoxicity?
- What is the emetogenic potential of the anticancer regimen and are antiemetics necessary?
- Is there a need for IV hydration and medications to prevent complications from tumor lysis syndrome?
- Are chemoprotectants necessary (eg, mesna for ifosfamide or cyclophosphamide, leucovorin for methotrexate)?
- Is there a need for urine alkalinization to prevent toxicity from methotrexate?
- Does the patient need an order for a colony-stimulating factor (eg, filgrastim, pegfilgrastim)?
- Are prophylactic antibiotics necessary (eg, immunosuppressive regimens such as high-dose chemotherapy, fludarabine, alemtuzumab)?
- Does the patient need anticoagulants to prevent the risk of thromboembolism (eg, lenalidomide and corticosteroids for multiple myeloma)?

Table 2-7 Prevention of Nephrotoxicity²⁴⁻²⁶

Nephrotoxicity: Clinicians should be aware of anticancer drugs that induce nephrotoxicity and be well versed in the preventive measures available for the anticancer agents.

Preventive Measures for Drugs Commonly Known to Cause Nephrotoxicity

Cisplatin: Saline based IV hydration maintained at 3-4 L/24 hours, 12 hours prior to and for at least 1 day after cisplatin administration. Potassium and magnesium supplementation as needed. Monitor renal function and reduce dose as indicated based on renal function.

Methotrexate: IV hydration with sodium bicarbonate to achieve urine alkalinization and maintain urine pH at 7 to prevent precipitation of the methotrexate in the renal tubules and collecting ducts. Begin hydration 12 hours before infusion of methotrexate and continue for 48-72 hours.

Bevacizumab: Monitor for proteinuria with a dipstick urinalysis and if result is 2+ or higher, it should be confirmed with a timed 24-hour urine collection. Hold bevacizumab if 24-hour urine collection shows protein amount greater than 2.

Infusion-Related Reactions

Some anticancer agents or the vehicles in which they are formulated may interact with mast cells and basophils producing anaphylactoid responses that are not true type 1 IgE-mediated hypersensitivity reactions. Mild-to-moderate infusion-related reactions are manifested as flushing, dyspnea, fever, rigors, chills, mild hypotension, and rash. Severe reactions are associated with bronchospasms, hypotension requiring treatment, cardiac dysfunction, and anaphylaxis. Infusion-related reactions may occur with all the monoclonal antibodies; however, the incidence varies among the different agents. Rituximab (77%) and trastuzumab (40%) produce the highest incidence rate, followed by cetuximab (12%), panitumumab (4%), and bevacizumab (3%). Infusion-related reactions predominantly occur with the first infusion, and the incidence declines with subsequent infusions. Premedications are recommended to prevent or reduce the severity of infusion-related reactions.^{27,28} Another chapter in this text, Overview of Cancer Therapy, provides a table of anticancer agents and recommendations for premedications as indicated to prevent infusion-related reactions for specific agents, including monoclonal antibodies.

Tumor Lysis Syndrome

Tumor lysis syndrome (TLS) is a set of metabolic complications that can arise from treatment of rapidly proliferating malignancies causing tumor cells to release their intracellular contents of potassium, phosphorus, and uric acid leading to the characteristic findings of hyperkalemia, hyperphosphatemia, hypocalcemia, hyperuricemia, and acute kidney injury.^{29,30} TLS may occur spontaneously prior to administration of anticancer therapy in tumors with high proliferative rates, or it may occur after anticancer therapy administration in tumors with high sensitivity to cytotoxic therapy. **Table 2-8** summarizes the risk factors for the development of TLS.^{29,30} The successful prevention and management of TLS involves maintaining a high index of suspicion and identifying patients who are at high risk for TLS along with the implementation of prophylactic strategies that prevent complications from TLS development (Table 2–8).²⁹⁻³¹

Chemotherapy-Induced Nausea and Vomiting

Chemotherapy-induced nausea and vomiting (CINV) can have negative effect on patients' quality of life and lead to poor compliance with anticancer therapy. It is essential that antiemetics are a component of anticancer treatment regimens for patients at risk of experiencing CINV to prevent metabolic imbalances, nutrient depletion, decline in performance status, and other complications that occur as a result of CINV. Criteria used to determine if antiemetics are necessary and the appropriate antiemetics to administer include: (1) the emetogenic potential of the specific anticancer agents, (2) the dose, schedule, and route of administration of the anticancer agent, (3) individual patient characteristics (eg, age, sex, history of alcohol use, CINV experience with prior anticancer therapy), (4) the side effect profile of the antiemetics, and (5) patient preference. Drugs commonly used to prevent and treat CINV include the 5-HT3 receptor antagonists (eg, ondansetron, granisetron, dolasetron, palonosetron), neurokinin-1 (NK-1) receptor antagonists (eg, aprepitant, fosaprepitant), corticosteroids (eg, dexamethasone), and antidopaminergic agents (eg, haloperidol, prochlorperazine, promethazine, and metoclopramide). Treatment recommendations for CINV are available at the following organizations' websites: the National Comprehensive Cancer Network (NCCN), the Multinational Association of Supportive Care in Cancer (MASCC), and ASCO (Table 2-9).

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Table 2-8 Identifying Risk Factors for Developing Tumor Lysis Syndrome²⁹⁻³¹

Cancer Diagnosis

Hematologic Cancers

Common	High-grade non-Hodgkin's lymphoma (eg, Burkitt's lymphoma), acute
	lymphocytic leukemia

Less Acute myeloid leukemia, chronic lymphocytic leukemia, multiple common myeloma, chronic myeloid leukemia in blast crisis

Solid Tumors With High Proliferative Rates and High Response Rate to Anticancer Therapy

Breast cancer, small lung cancer, testicular cancer

Tumor-related Risk Factors

High tumor cell proliferation rate, tumor size, tumor sensitivity to anticancer therapy

Patient Risk Factors

Preexisting chronic renal insufficiency, decreased urinary flow, acidic urine, dehydration, preexisting hyperuricemia, hypotension, receiving concomitant nephrotoxic drugs

Laboratory Risk Factors

High white blood cell (WBC) count, high lactate dehydrogenase (LDH) level (greater than $2 \times$ upper limit of normal range), elevated uric acid level

Recommendations for Prevention of Complications From Tumor Lysis Syndrome

Hydration	Intravenous hydration with 2.5-3 L/day of fluids to maintain urine output of 2 mL/kg/hour. Initiate 24 hours prior to and continue for up to 72 hours after anticancer therapy. The addition of a diuretic may be necessary.
Hyperuricemia	Initiation of prophylactic allopurinol prior to anticancer therapy is recommended for patients at low risk (normal uric acid level, WBC $\leq 50 \times 10^9$ /L, normal LDH) of developing TLS.
	Rasburicase is recommended for patients with high risk (uric acid level > 8 mg/dL, WBC \ge 50 × 10 ⁹ /L, high LDH, receiving intensive anticancer therapy) factors for TLS.
Electrolytes	Unless it is medically necessary, discontinue potassium and phosphate electrolyte supplementations.
Laboratory monitoring	Obtain laboratory tests (serum creatinine, LDH, uric acid, potassium, phosphorus, calcium) daily for patients at low risk for TLS, every 8-12 hours for high-risk patients, and every 4-6 hours for patients who have established TLS.

Table 2-9 Oncology Professional Organizations, Websites, and Resources

American Society of Clinical Oncology (ASCO)	www.asco.org
Examples of some available guidelines or clinical opinions:	-
 Appropriate Chemotherapy Dosing for Obese Adult Patients With Cancer 	
Antiemetics	
• Update on the Use of Epoetin and Darbepoetin in Adult Patients With Cancer	
 Chronic Hepatitis B Virus Infection Screening in Patients Receiving Cytotoxic Chemotherapy for Treat- ment of Malignant Diseases 	
• Use of Chemotherapy and Radiation Therapy Protec- tants	
• Update of Recommendations for the Use of White Blood Cell Growth Factors: An Evidence-Based Clini- cal Practice Guideline	
• Venous Thromboembolism Prophylaxis and Treatment in Patients With Cancer	
 Testing for KRAS Gene Mutations in Patients with Metastatic Colorectal Carcinoma to Predict Response to Anti-Epidermal Growth Factor Receptor Monoclo- nal Antibody Therapy 	
• Epidermal Growth Factor Receptor (EGFR) Mutation Testing for Patients With Advanced Non–Small Cell Lung Cancer Considering First-Line EGFR Tyrosine- Kinase Inhibitor (TKI) Therapy	
Chemoregimen Website	www.chemoregimen.com
 Lists the most common anticancer regimens organized by disease state. The regimens include drug, dosage, and schedule with links to the primary references 	
 Links to dosing of anticancer therapy in renal and hepatic impairment 	
Children's Oncology Group (COG)	www.childrensoncology group.org
 Access to protocols used in the treatment of childhood cancers 	
 Long-term follow-up guidelines for screening and management of late effects of cancer and cancer therapy 	

The Gynecologic Oncology Group (GOG)	www.gog org
Access to the website is available for members. Information regarding the treatment of pelvic malignancies such as cancer of the ovary, cervix, and uterus.	
Hematology/Oncology Pharmacy Association (HOPA)	www.hoparx.org
Newsletter that provides a review of the most recent FDA-approved anticancer therapies and timely topics.	
Multinational Association of Supportive Care in Cancer (MASCC)	www.mascc.org
Some example guidelines provided include:	
 Antiemetics, mucositis, EGFR inhibitor skin toxicity, oral agent teaching tool 	
National Cancer Institute (NCI)	www.cancer.gov
 List of NCI clinical trials 	
 General overview of different cancers and cancer treatment 	
National Comprehensive Cancer Network (NCCN)	www.nccn.org
• Guidelines for the treatment of the major cancers	
• Guidelines for age-related recommendations (adolescent, young adult, and senior adult)	
• Guidelines for supportive care. Examples include:	
 Antiemesis, myeloid growth factors, chemotherapy and cancer-induced anemia, prevention and treatment of cancer-related infections, venous thromboembolic disease, pain and palliative care management, distress management, survivorship Cuidelines for creaning 	
• Guidelines for screening	
The Oncology Nursing Society (ONS)	www.ons.org
Review of the major common cancers	
• Clinical practice resources for chemotherapy- induced nausea and vomiting, oral mucositis, safe handling, oral therapies, and vincristine	

This list is not all inclusive and is intended only as a point of reference.

Febrile Neutropenia and Colony-Stimulating Growth Factors

Neutropenia (defined as < 500 neutrophils/microliter or < 1000 neutrophils/ microliter with a predicted decline to ≤ 500 neutrophils/microliter over the next 48 hours) and the possibility of febrile neutropenia (defined as temperature \geq 38.3° C or $\geq 38^{\circ}$ C over 1 hour) development is a consequence of myelosuppressive anticancer therapy. Febrile neutropenia (FN) is a dose-limiting toxicity of anticancer therapy that requires hospitalization and broad-spectrum antibiotic administration. Furthermore, FN may cause treatment delays and dose reductions that can adversely affect clinical outcomes. The administration of granulocyte colony-stimulating factors (G-CSFs) with each cycle of anticancer therapy can reduce the risk of developing FN or the severity and duration of FN. It is essential to consider if patients require the addition of a granulocyte colony-stimulating factor to their anticancer treatment regimen to prevent chemotherapyinduced FN and help patients stay on track with their treatment schedule. The most commonly prescribed granulocyte colony-stimulating factors are filgrastim and pegfilgrastim, and updated guidelines for the use of these agents are available at the NCCN website (Table 2-9).

NONONCOLOGY INDICATIONS FOR ANTICANCER THERAPY

Anticancer therapies are indicated for ectopic/molar pregnancies and many autoimmune disorders such as rheumatoid arthritis, systemic lupus erythematosus, Sjögren's syndrome, Crohn's disease, Wegener's granulomatosis, and multiple sclerosis. The anticancer agents most commonly used to treat autoimmune disorders include cyclophosphamide, mitoxantrone, methotrexate, and rituximab. Utilizing anticancer therapy for nononcology indications requires the same evaluation and monitoring as for oncology indications. Anticancer therapy for nononcology patients is administered in cancer centers because they are equipped and have staff that are qualified and experienced in providing cytotoxic therapy. It is important to establish good communication channels between nononcology practices and the oncology treatment center so that treatment plans can be verified and adhered to correctly. The oncology treatment center needs to have access to the patient's chart and laboratory data to be able to determine if it is safe and appropriate for the patient to be treated. In addition, many of these agents are expensive, and treatment centers need to be able to predict patient need to manage inventory. When verifying orders for nononcology indications, it is important to

know the diagnosis, the correct dose for the indication, and follow the same steps to verify the prescription as for oncology indications (see Table 2-3).

RESOURCES

There are many professional organizations and cooperative groups dedicated to promoting the delivery of high-quality care for oncology patients; cancer prevention, research, and advocacy; and ongoing education and professional development of oncology healthcare providers. These organizations have online resources that provide access to clinical guidelines and recommendations developed by expert panels based on best available evidence, educational events, and newsletters or journals that publish the latest data on the advances in the treatment of cancers. The online sites for these professional organizations and cooperative groups are excellent resources to stay current in the field of oncology. Oncology healthcare professionals should investigate these various websites to identify situations in which they will be beneficial in the course of providing care for the cancer patients. Table 2-9 provides a listing of key oncology professional organizations and resources along with a brief summary of guidelines/information that are available at the website.

In addition to the resources listed in Table 2-9, package inserts are often overlooked, valuable resources. They provide preparation, dosing, and administration guidelines as well as a comprehensive list of adverse events. Micromedex is a webbased resource that is available via subscription in many institutions. It provides valuable drug information on individual systemic anticancer agents and answers many questions regarding drug interactions along with IV drug and solution compatibility.

SUMMARY

The field of oncology is rapidly changing and improving to provide patients with better treatment outcomes. The improved treatment plans are often much more complex and errors can cause serious harm to patients. The prescribing and verification process must include a systematic approach that is provided in policies and procedures to ensure patients are treated both safely and effectively. All healthcare professionals involved in oncology should be vigilant in following standard of practice when prescribing, verifying, dispensing, and administering anticancer agents. Healthcare providers should also communicate with each other openly in order to facilitate correction of errors when they are identified.

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