Basics of Cancer Care Workshop

“Systemic Therapy”

Nursing Division,

Ministry of Health, Malaysia

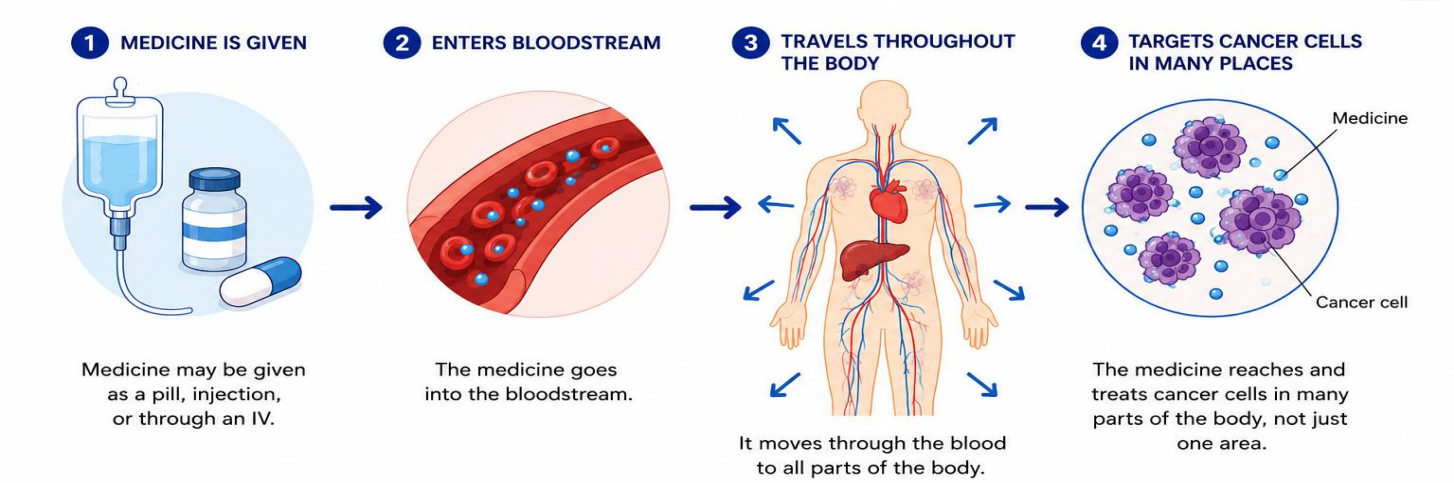
Learning Outcomes

By the end of this lesson, learners will be able to:

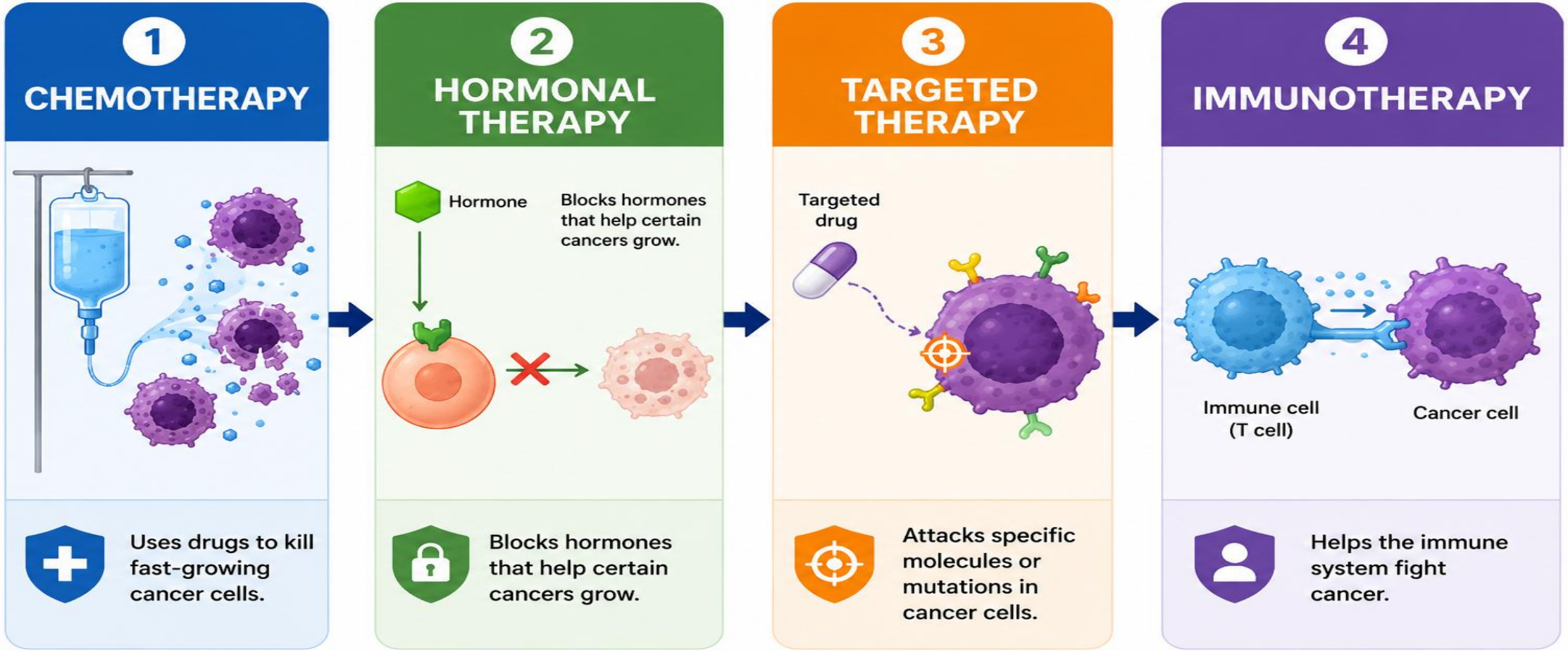
- Explain various systemic therapy agent and its management

What is Systemic Therapy?

- Treatments that travel through the bloodstream to reach cancer cells throughout the body, not just in one specific area (National Cancer Institute. (n.d.), 2026).
- This is different from “local” treatment like surgery or radiation, which target only one part of the body.



Type of Systemic Therapy



Systemic Therapy

Chemotherapy

What is Chemotherapy ?

- Known as Antineoplastic therapy & Cytotoxic therapy (Amjad et al., 2023).
- Use of powerful drugs to destroy cancer cells and prevent them from growing, dividing, and spreading throughout the body.
- Chemotherapy usually required multiple cycles.



Goals of Chemotherapy



CURE

- The tumor is eradicated



TO CONTROL

- Extend remission
- Reduce relapse risk



PALLIATION

- Relieve symptoms
- Improve quality of life

Terminologies Used in Chemotherapy

FEATURE	NEOADJUVANT	ADJUVANT	PALLIATIVE
Timing	Before Surgery	After Surgery	Stage 4
Main Goal	Shrink Tumor	Prevent Recurrence	Relieve Symptoms
Intent	Curative (usually)	Curative (usually)	Quality of Life

Principles of Chemotherapy

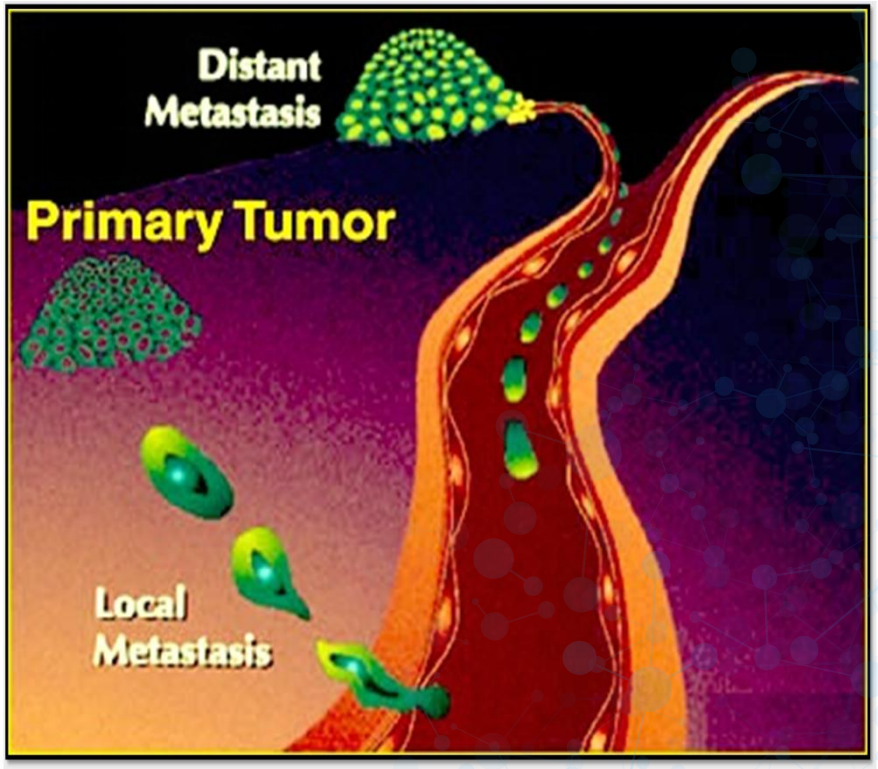
4 PRINCIPLES

1. Hematopoietic System And Solid Tumors
2. Cellular Kinetics
3. Combination Chemotherapy
4. Therapeutic Response

1. Hematopoietic System and Solid Tumours

- Chemotherapy is commonly used to treat cancers of the hematopoietic system and solid tumors that have spread to nearby or distant parts of the body.

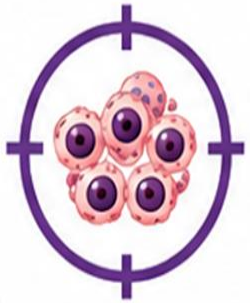
Hematopoietic system cancers	Solid tumors
• Affect blood and blood-forming tissues	• form physical masses in organs or tissues



2. Cellular Kinetics

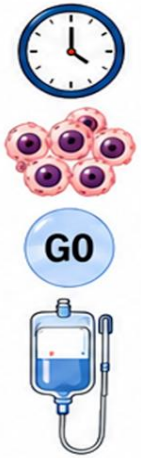
1 CELL LIFE CYCLE

- Chemotherapy drugs mainly target rapidly dividing cells.
- They can also affect non-dividing cells, but less effectively.
- Their effectiveness varies depending on the stage of the cell cycle.



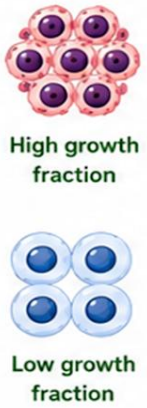
2 CELL CYCLE TIME

- The time taken for a cell to go from one division (mitosis) to the next is called the cell cycle time.
- This cycle length differs depending on the type of cell.
- The G0 phase length is the main factor that determines overall cell cycle time. A shorter cycle allows greater cancer cell kill with cell cycle–specific drugs.
- Continuous infusion of these drugs exposes more cells over time, leading to better cancer cell kill, especially in tumors with short cycle times.



3 GROWTH FRACTION

- Growth fraction is the percentage of cells that are actively dividing at a given time.
- Tissues with many dividing cells and few in G0 have a high growth fraction and respond better to Chemotherapy (e.g., AML and aggressive lymphomas).
- Tissues with mostly G0 cells have a low growth fraction and are less sensitive to chemotherapy.
- Chemotherapy can also damage normal fast-growing tissues such as bone marrow, gastrointestinal lining, hair follicles, and sperm-producing cells.



4 TUMOR BURDEN

- Tumor burden refers to the number of cancer cells in a tumor.
- Small tumors usually respond better to Chemotherapy because they are better supplied with blood vessels.
- As tumors grow larger, the growth fraction decreases and more cells stop actively dividing.
- The center of large tumors often has poor blood flow, reducing oxygen, nutrients, and drug delivery.
- Larger tumor size increases the chance of drug resistance.
- Many cells in large tumors enter the G0 phase, making them less sensitive to chemotherapy.

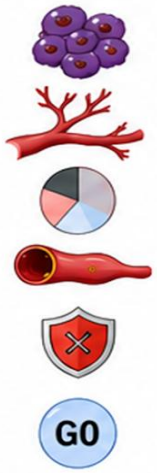


Figure 1. Cellular Kinetics

3. Combination Chemotherapy

- Combination chemotherapy improves cancer cell kill while reducing resistance and improving treatment success.
- Different Chemotherapy drugs work at different stages of the cell growth and division cycle.

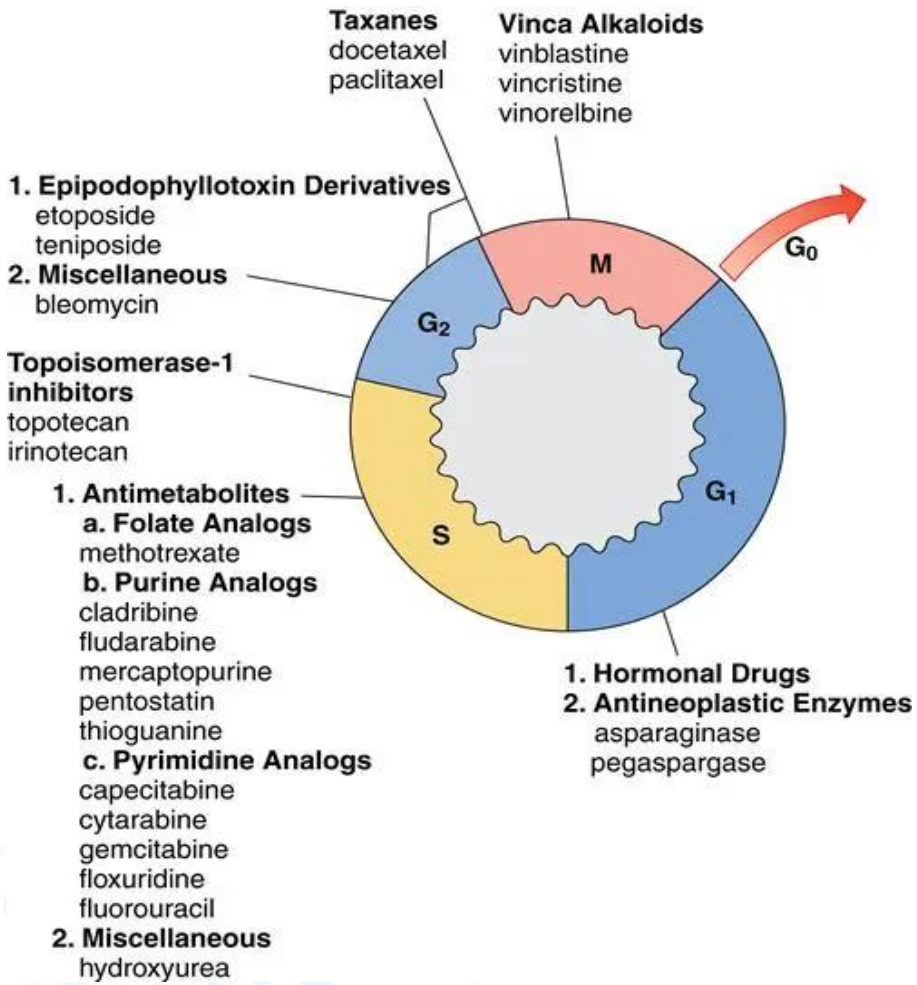


Figure 2. Stages of The Cell Growth and Division Cycle

Combination Chemotherapy (Cont.)

Principles of Combining Chemotherapy Agents		
Mechanism of action	The drugs should have different, complementary mechanisms of action (prevent resistance).	• Carboplatin (cell cycle non-specific) • Gemcitabine (cell cycle specific)
Activity and scheduling	Each drug must have shown activity for that type of cancer when given as a single agent and be given in a similar scheduling and dosing (synergistic activity).	• Carboplatin and gemcitabine – each has a single Agent response in lung cancer and is given 3-weekly.
Toxicities	The toxicities of the drugs should also be different to minimize overall toxicity.	• Carboplatin: thrombocytopenia • Gemcitabine: neutropenia • Combination results = thrombocytopenia.

Combination Chemotherapy (Cont.)

Principles of Combining Chemotherapy Agents	
Dose intensity	• The total amount of drug delivered to the patient over a week. • Those patients whose treatment was delayed or dose reduced (resulting in reduced intensity) relapses occurred more frequently.
Dose density	• The method of giving a drug in small repeated amounts frequently rather than as a single high dose less often.

4. Therapeutic Response

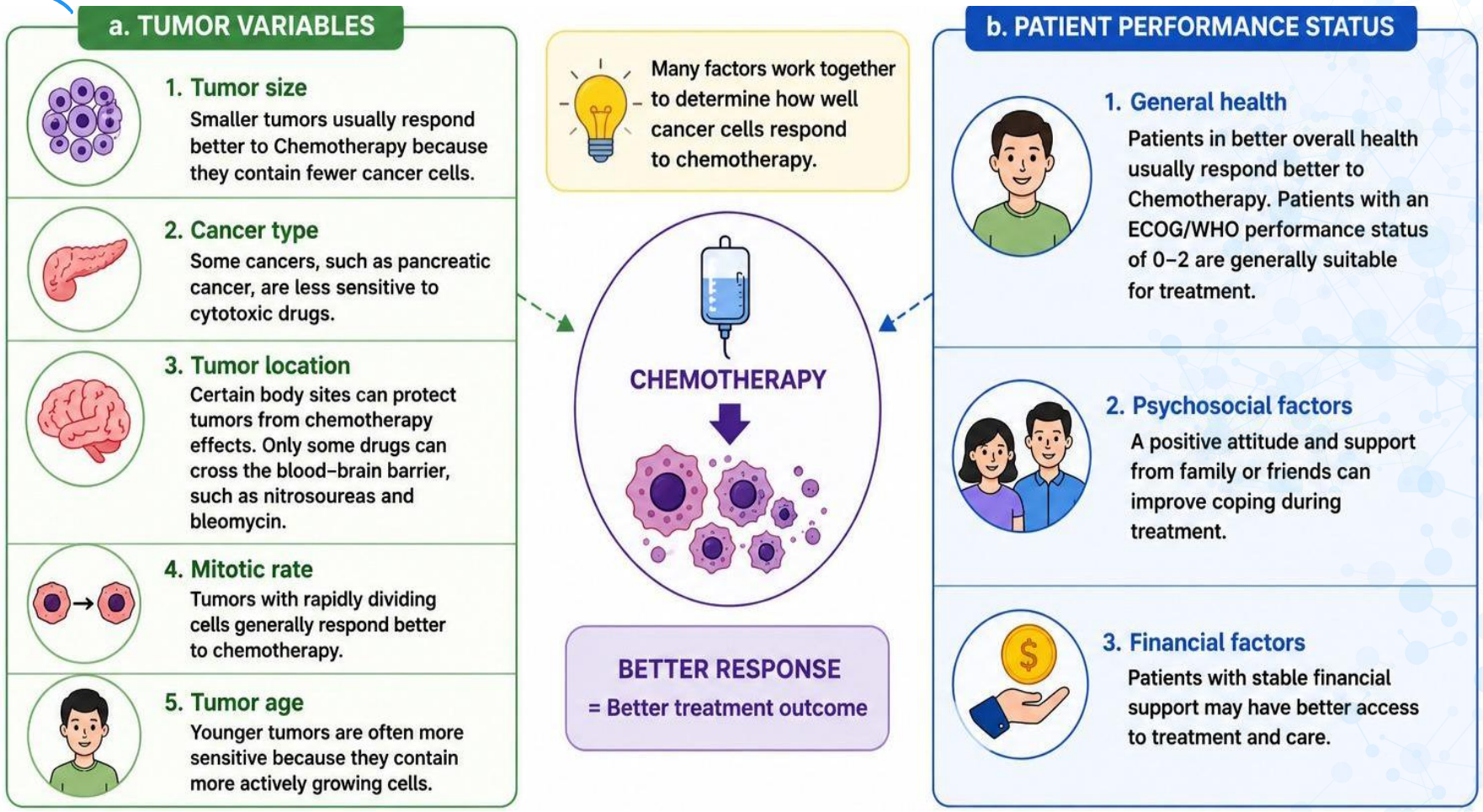
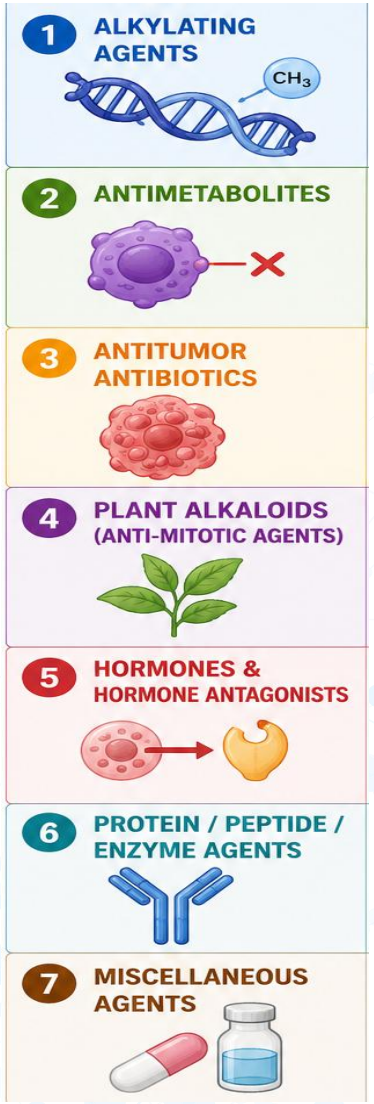


Figure 3. Therapeutic Response

Classifications of Chemotherapeutic Agents

- Chemotherapy agents are divided into different categories according to their mechanism of action.
- The rationale behind chemotherapy is to inhibit or kill rapidly dividing cancer cells.
- This may be due to the drug acting at a particular point in the cell cycle (cell cycle-specific) or is independent of the cell cycle (cell cycle-nonspecific).



Classifications of Chemotherapeutic Agents (Cont.)

CLASS.	METHOD OF ACTION	EXAMPLE
Alkalyting agent	Create defects in tumour DNA	Cyclophosphamide, Cisplatin, Carboplatin, Oxaliplatin, dacarbazine, Ifosfamide
Anti-tumour Antibiotic	Break or damage DNA and interfere with DNA repair	Doxorubicin, Epirubicin, Bleomycin, Mitomycin
Anti-metabolites	It combine, or replace key enzymes at the regulatory sites	5-FU, Xeloda, Gemcitabine, Methotrexate
Plant Alkaloids	Binding to micro tabular proteins and causes mitotic arrest	Vinblastine, Vincristine, Vinorelbine, Taxane (Paclitaxel), Docetaxel
DNA-Topoisomerase Inhibitors	Cleave one or two strands of DNA and block certain enzymes needed to reproduce	Irinotecan, Etoposide
Miscellaneous agents	Inhibit protein synthesis in tumour cells	Procarbazine

Systemic Therapy

Hormonal Therapy

Hormonal Agents

Use in the treatment of hormone-sensitive cancer such as breast and prostate cancer (Abraham, 2023) .

KEY POINTS
• Commonly involves the use of glucocorticoids.
• Direct antitumor effects are related to their lymphocytic properties.
• Glucocorticoids can inhibit mitosis, RNA synthesis and protein synthesis in sensitive lymphocytes.
• Considered cell-cycle nonspecific.
• Resistance to a given glucocorticoid may develop rapidly and typically extends to other glucocorticoids.

EXAMPLES

- Prednisone
- Tamoxifen
- Estrogens
- Flutamide
- Nilutamide
- Bicalutamide

Hormonal Agents (Cont.)

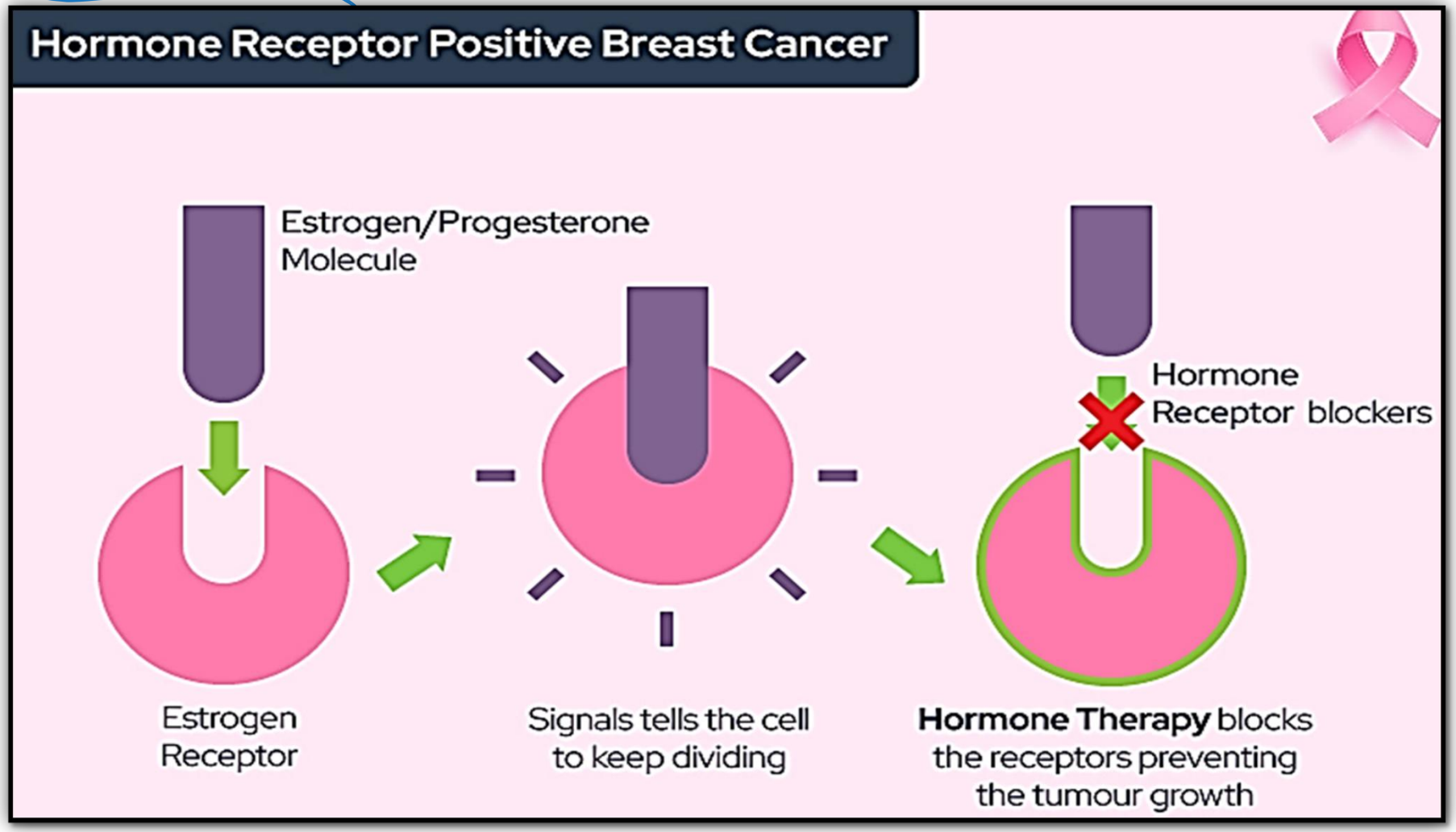


Figure 4. Hormone Receptor Positive Breast Cancer

Systemic Therapy

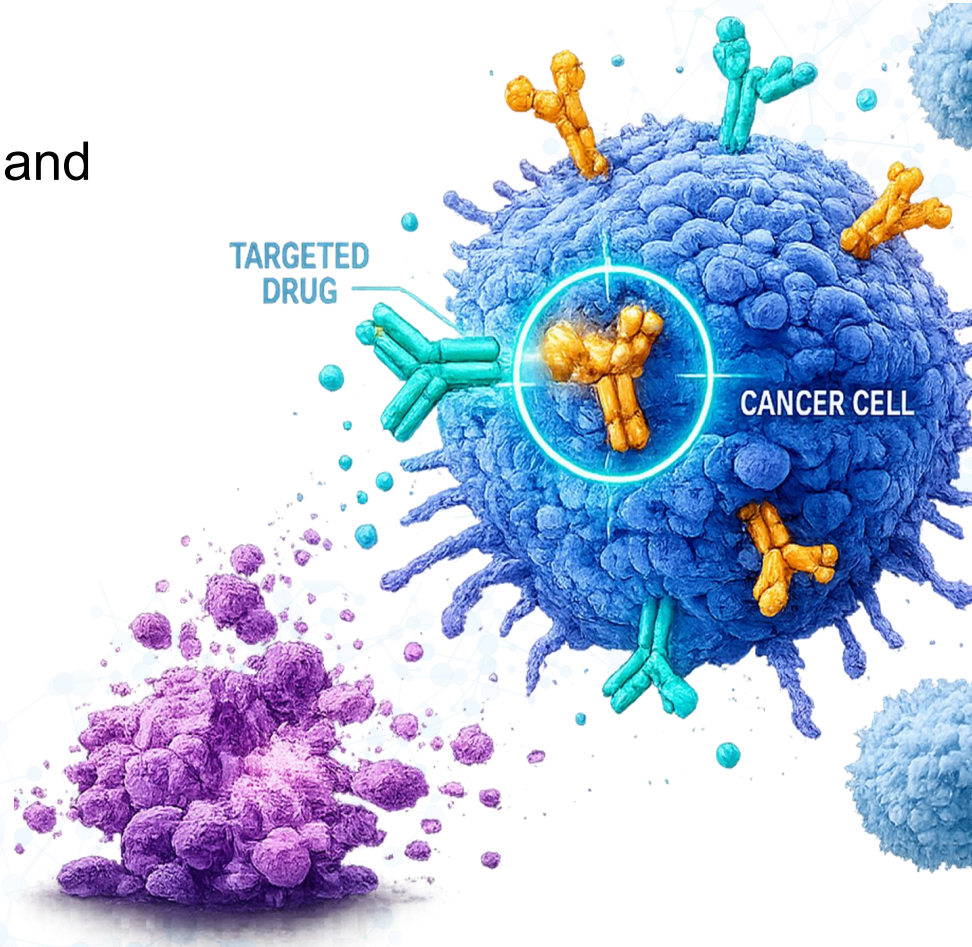
Targeted Therapy

What is Targeted Therapy ?

- Targets proteins that control how cancer cells grow, divide, and spread (Tilak et al., 2023).

- Some of the substances in cancer cells that become the "targets" of targeted therapies:

  - Too much of a certain protein on a cancer cell
  - A protein on a cancer cell that is not on normal cells
  - A protein that is mutated (changed) on a cancer cell
  - Gene (DNA) changes that aren't in a normal cell



Types of Targeted Therapy

Small-Molecule Drugs

- Are small enough to enter cells easily, so they are used for targets that are inside cells

Monoclonal antibodies/ Therapeutic antibodies

- Some monoclonal antibodies mark cancer cells so that they will be better seen and destroyed by the immune system.
- Other monoclonal antibodies directly stop cancer cells from growing or cause them to self-destruct

Targeted Therapies

Examples of some targeted therapies

01	**Angiogenesis inhibitors** e.g. bevacizumab	VEGF
02	**Monoclonal antibodies** e.g. trastuzumab	HER2
03	**Proteasome inhibitors** e.g. bortezomib	26S proteasome
04	**Signal transduction inhibitors** e.g. imatinib	BCR-ABL

Angiogenesis Inhibitors

- Block the formation of new blood vessels
- Eg: Bevacizumab (+ Carboplatin and paclitaxel)
- The first-line treatment of non-small cell lung cancer
- Patients with unresectable, locally advanced, recurrent, or metastatic adenocarcinoma

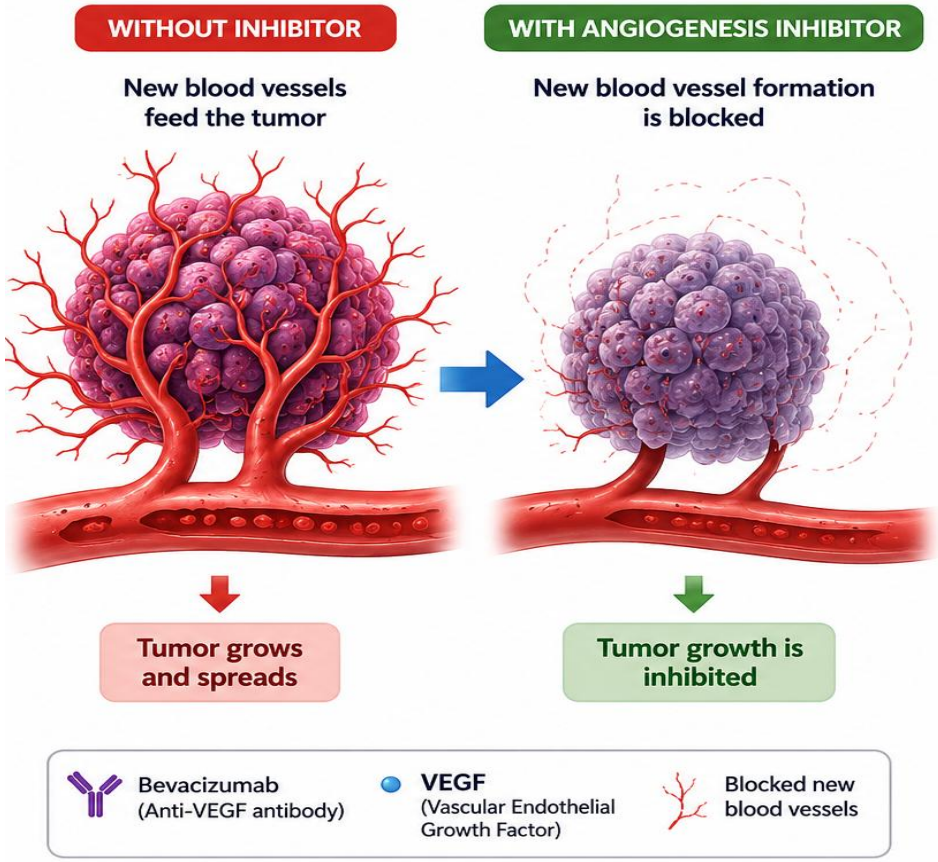


Figure 5. Comparison of Tumour with Inhibitor and without Inhibitor

Monoclonal Antibodies

- These might deliver molecules by themselves or molecules with drugs into or onto the cancer cell to kill it
- They have a specific target on a cancer cell that they aim to find, attach to, and attack
- Example: Blinatumomab (Blincyto)

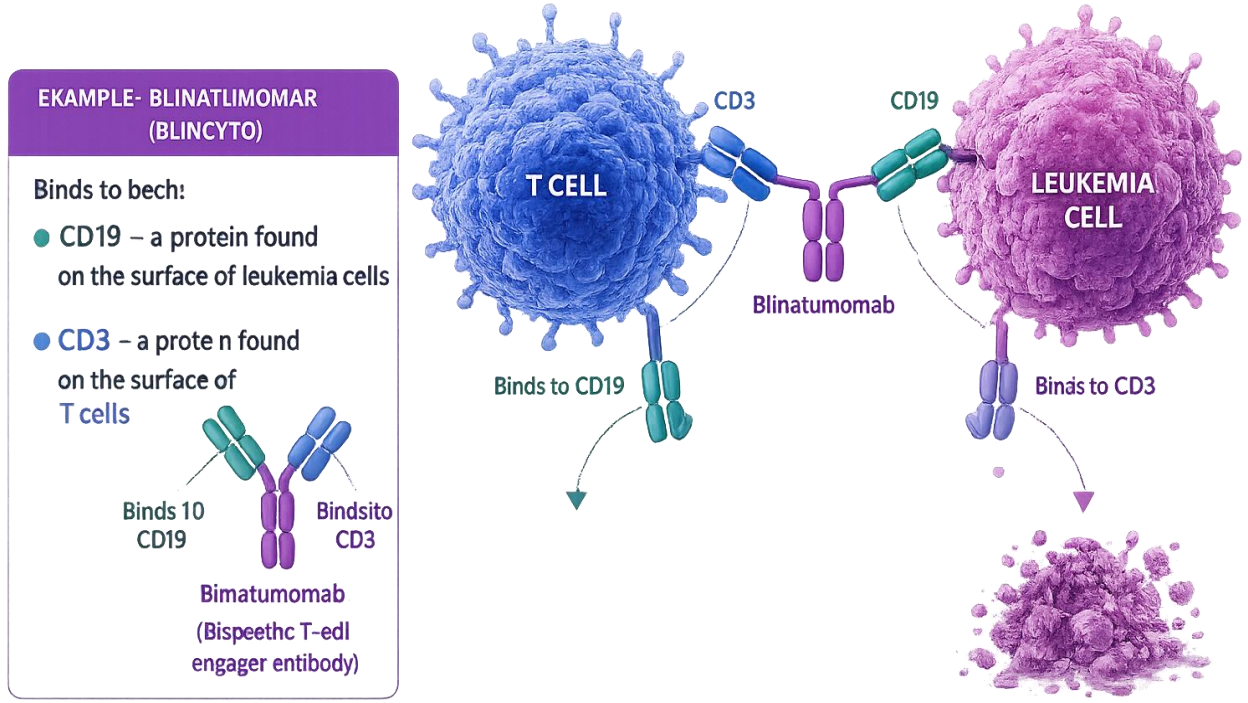


Figure 6. Action of Monoclonal Antibodies with Tumour Cells

Monoclonal Antibodies (Cont.)

	Monoclonal Antibody Products			
	Name	Type	Target	Clinical
Rituxan	Rituximab	Chimeric	CD20	NHL
Herceptin	Trastuzumab	Humanized	Erb B2	Breast
Avastin	Bevacizumab	Humanized	VEGF	Colorectal
Campath	Alemtuzumab	Humanized	CD52	CLL
Erbitux	Cetuximab	Chimeric	EGFR	Colorectal
Vectibix	Panitumumab	Human	EGFR	Colorectal

Abbreviations: NHL, non-Hodgkin's lymphoma; VEGF, vascular endothelial growth factor; CLL, chronic lymphocytic leukemia; EGFR, epidermal growth factor receptor.

Figure 7. Types of Monoclonal Antibodies

Proteasome Inhibitors

- These disrupt normal cell functions, so the cancer cells die
- Example: Bortezomib (multiple myeloma)

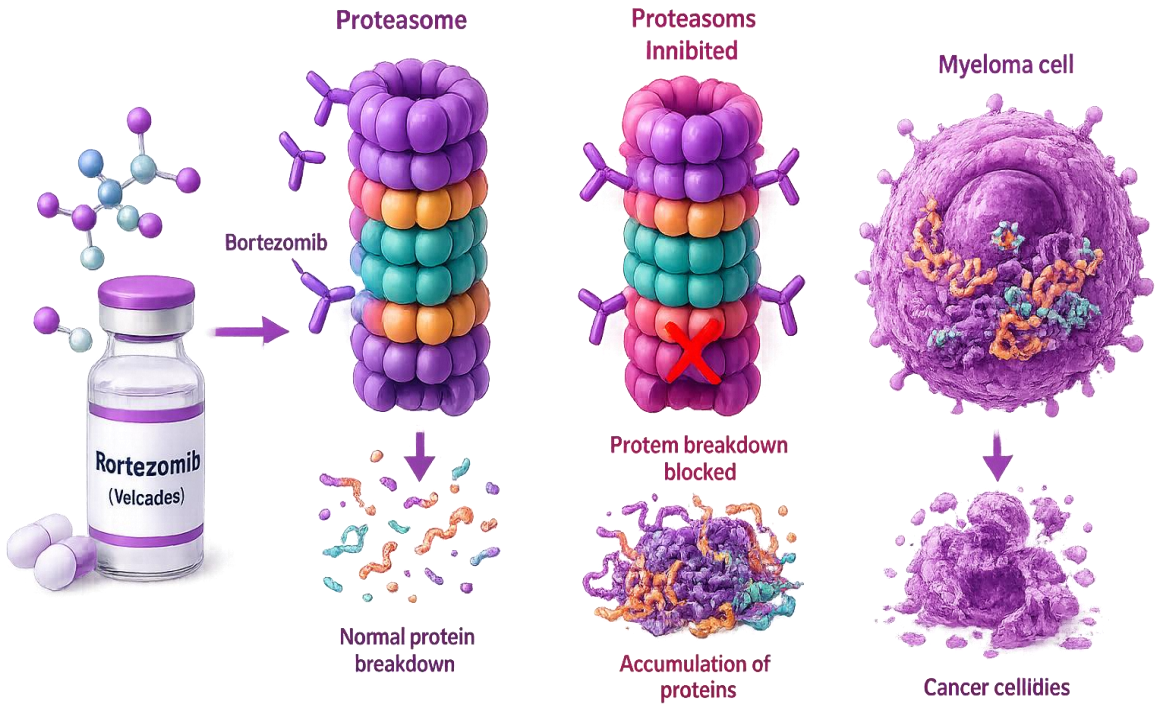


Figure 8. Action of Proteasome Inhibitors in Myeloma Cells

Signal Transduction Inhibitors

- These disrupt cell signals so that they change the actions of the cancer cell
- Example: Imatinib (certain chronic leukemias)

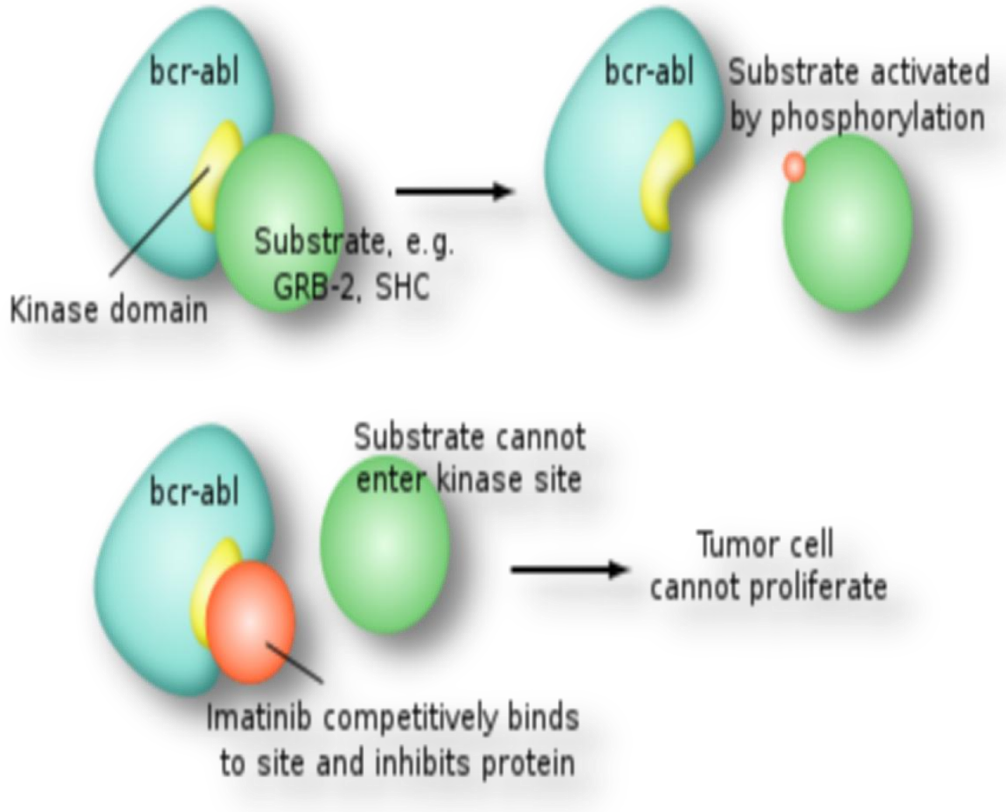


Figure 9. Action of Transduction Inhibitors in Tumour Cell

Systemic Therapy

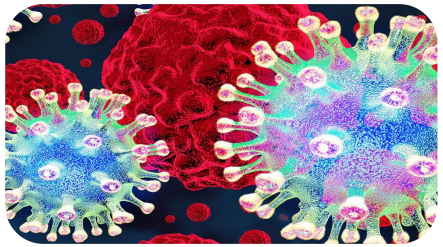
Immunotherapy

What is Immunotherapy ?

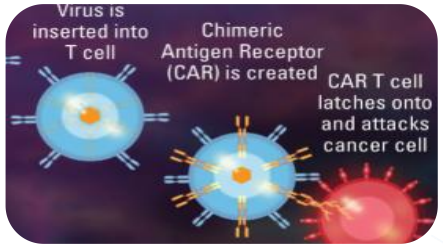
- Cancer treatment that boosts the body's natural defenses to fight cancer (Couzin-Frankel, 2013).
- Types of immunotherapy:



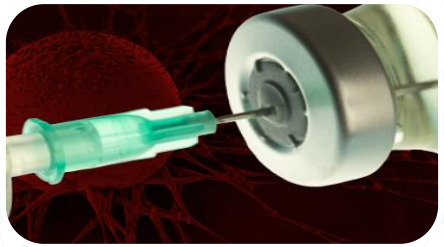
Monoclonal antibodies and tumor-agnostic treatments



Oncolytic virus therapy



T-cell therapy



Cancer vaccines

Oncolytic Virus Therapy

- Oncolytic viruses are a form of immunotherapy that uses viruses to infect and destroy cancer cells.

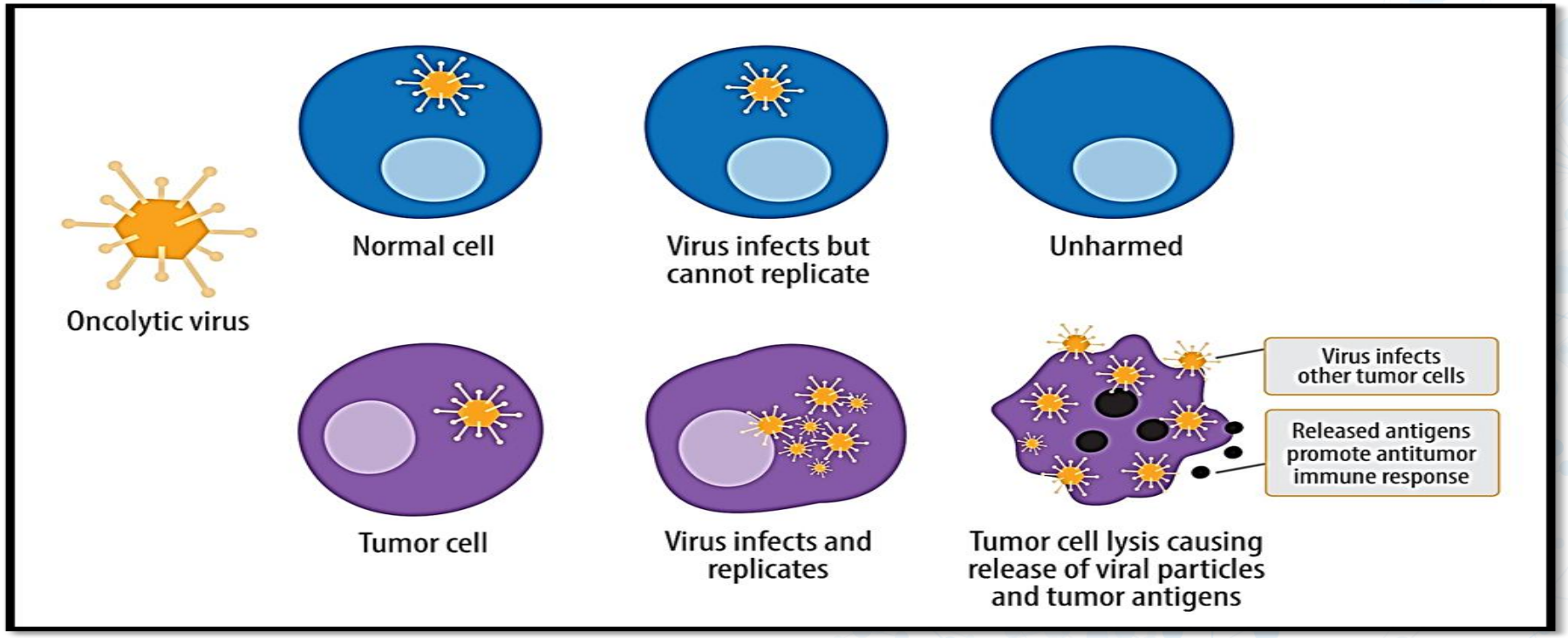


Figure 9. Oncolytic Virus Therapy

Chimeric Antigen Receptor (CAR) T-Cell Therapy

- Oncolytic viruses are a form of immunotherapy that uses viruses to infect and destroy cancer cells.
- CARs are designed to allow the T- cells to attach to specific proteins on the surface of the cancer cells, improving their ability to attack the cancer cells.

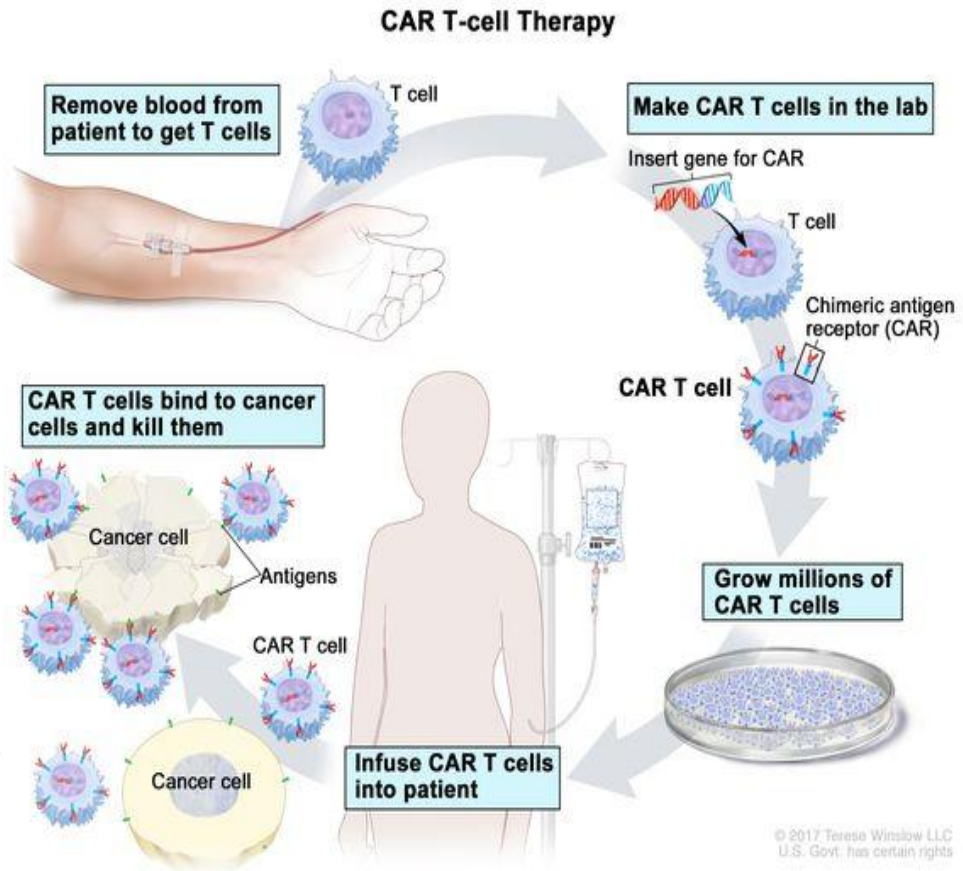


Figure 10. Chimeric Antigen Receptor (CAR)

Immunomodulators

- These substances change the body's biologic response
- Enhance the body's immune response against cancer:
  - Cytokines, which are proteins made by white blood cells.

Interferon(INFs)
- Slow the growth of cancer cells or promote their death.

Interleukins(ILs)
- Boosts the number of white blood cells in the body, including killer T cells and natural killer cells.

Immunomodulators (Cont.)

- Cytokines that are used to reduce side effects from cancer treatment by promoting the growth of blood cells that are damaged by chemotherapy

Erythropoietin	IL-11	Granulocyte-macrophage colony-stimulating factor (GM-CSF) and granulocyte colony-stimulating factor (G-CSF)
• Increases the production of red blood cells	• Increases the production of platelets	• Boosting white blood cells reduces the risk of infections

Immunomodulators (Cont.)

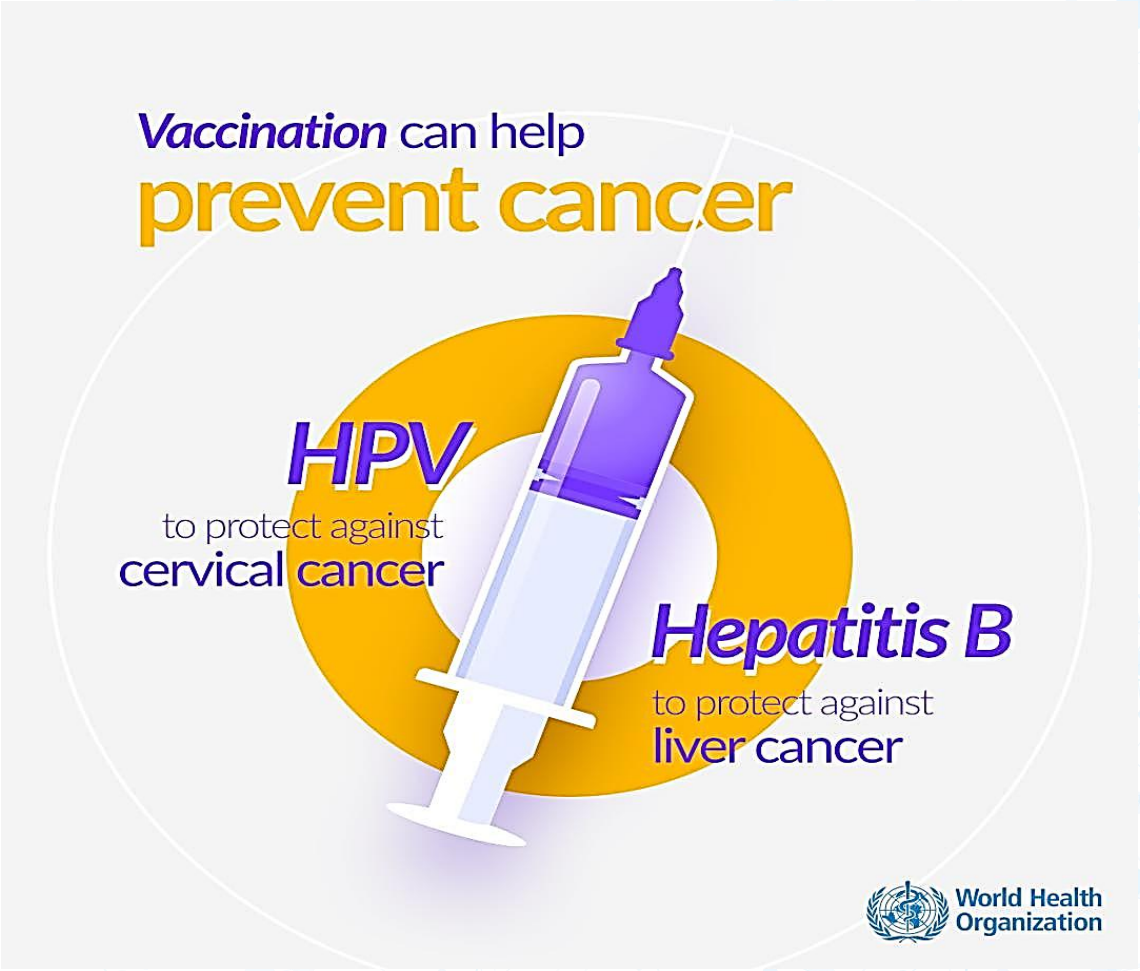
- **Bacillus Calmette-Guérin (BCG)**
  - used to treat bladder cancer.
  - When inserted directly into the bladder with a catheter, BCG causes an immune response against cancer cells.

- Immunomodulatory drugs (also called biological response modifiers) - stimulate the immune system and stop tumors from forming new blood vessels.

  - thalidomide (Thalomid)
  - lenalidomide (Revlimid)
  - pomalidomide (Pomalyst)
  - imiquimod (Aldara, Zyclara)

Cancer Vaccines

- Vaccines stimulate an immune response to protect the body against certain diseases



Systemic Therapy

Chemotherapy:
Pharmacological Aspect

Oncology Drug Interactions

Interactions	Descriptions	Example
Pharmaceutical	Occurrence is due to physical or chemical incompatibility	Inactivation of cisplatin by mesna
Pharmacodynamics	One drug has an antagonistic, additive or synergistic effects on another	Additive effects of gemcitabine and cisplatin in the treatment of NSCLC
Pharmacokinetic	One drug alters the absorption, distribution, metabolism or excretions of the other	Increased availability of mercaptopurine in the presence of allopurinol

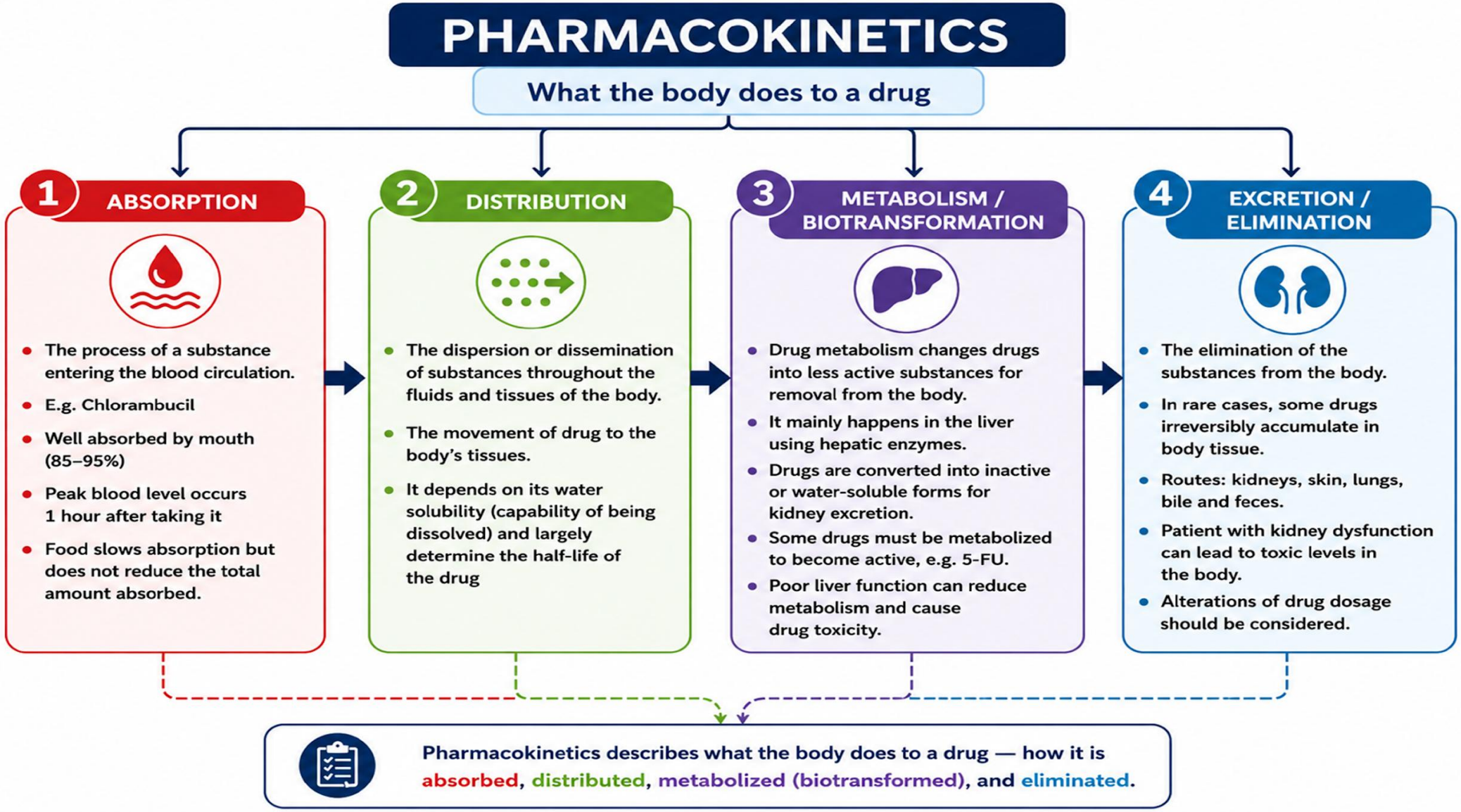


Figure 12. Pharmacokinetics of Chemotherapy Drugs

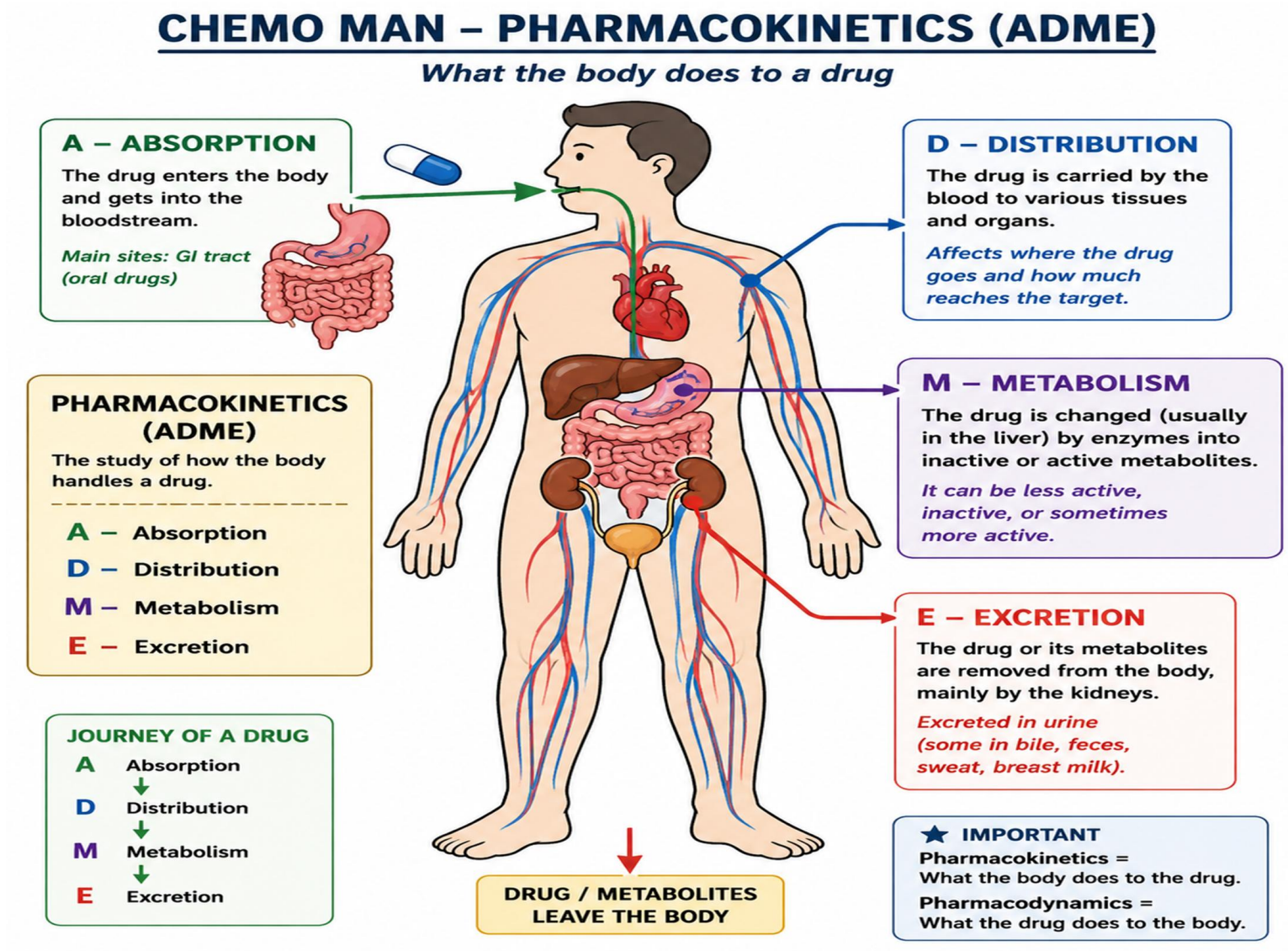


Figure 12. Chemo Man for Pharmacokinetics

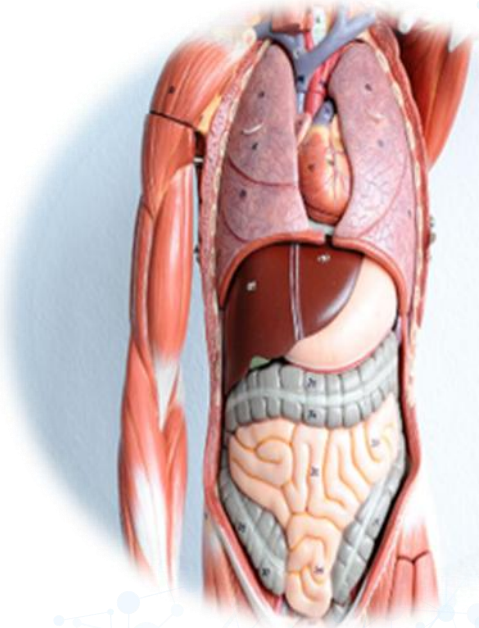
Systemic Therapy

Chemotherapy:
Chemotherapy Process

Administration of Chemotherapy



Systemic



Regional

Systemic Therapy

- The goal is to achieve enough drug concentration to destroy cancer cells while minimizing damage to normal tissues.

Routes administration:


Oral


Intravenous


Subcutaneous


Intramascular



Systemic Therapy: Oral

- The most convenient way to administered any medication.

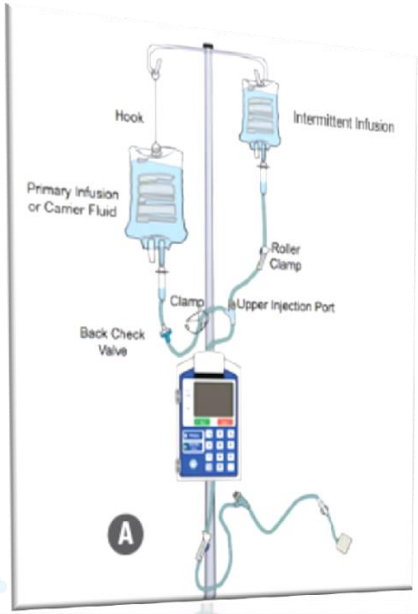
- Factors need to be considered:
  - The availability of the drug in an oral formulation
  - The functioning of the GIT-diarrhea, nausea, vomiting or dysphagia
  - The patient's level of consciousness
  - Patient compliance

- **Advantage:**
  - Easy to administered and non-invasive
  - Economical
  - Reduced LOS

- **Disadvantage:**
  - Inconsistency of absorption



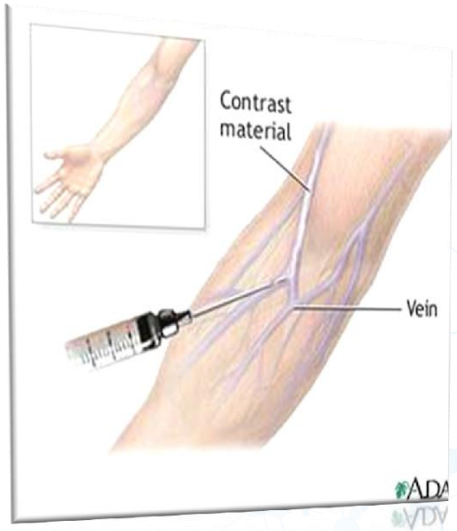
Systemic Therapy: Intravenous



Piggyback



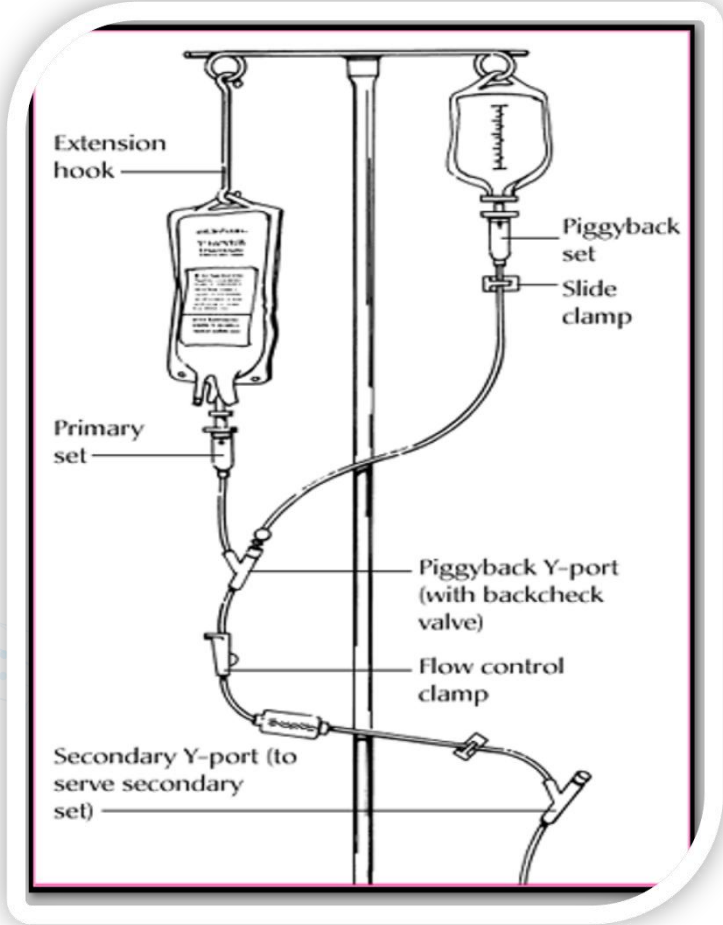
Infusion





IV Push/Bolus

Systemic Therapy: Intravenous (Piggyback)



- Drug is administered using secondary bag and tubing primary infusion is concurrently maintained through drug administration
- Reason:
  - Maintain IV flow
  - Reduce vein irritation
  - Maintain vein patency
  - Allow flushing before and after chemotherapy
  - Control infusion rate safely
- Example:
  - Paclitaxel administered with normal saline primary infusion

Systemic Therapy: Intravenous (Infusion)



- Drug is added to prescribed volume of fluid IV bag continuous or intermittent flow is used
- Example:
  - Fluorouracil continuous infusion
  - Cisplatin intermittent IV infusion
  - Gemcitabine diluted in normal saline infusion

Systemic Therapy: Intravenous (IV Push/ Bolus)



- Administered through syringe directly into the vein
- Example:
  - Vincristine
  - Doxorubicin
  - Methotrexate
  - Bleomycin

Systemic Therapy: Intravenous (Cont.)

Advantage	Disadvantage
• Consistent absorption • Required for vesicant	• Sclerosing of veins over time • Potential infection / phlebitis

Systemic Therapy: Intravenous (Cont.)

Advantage	Disadvantage
• Consistent absorption • Required for vesicant	• Sclerosing of veins over time • Potential infection / phlebitis

Systemic Therapy: Subcutaneous

- Subcutaneous administration is the delivery of medication into the fatty tissue layer under the skin and above the muscle.

Example:

- Methotrexate (MTX) treat leukemia
- Certain types of cancer of the breast, skin, head and neck, lung, or uterus

Disadvantages:

- The harshness of the chemo drugs
- Bleeding
- Infection



Systemic Therapy: Subcutaneous

- The needle goes into the space between the skin and muscle

- Example:
  - Herceptin(Biological therapy) (Ca Breast)
  - Cytarabine/Ara-C (Leukemia/Lymphoma

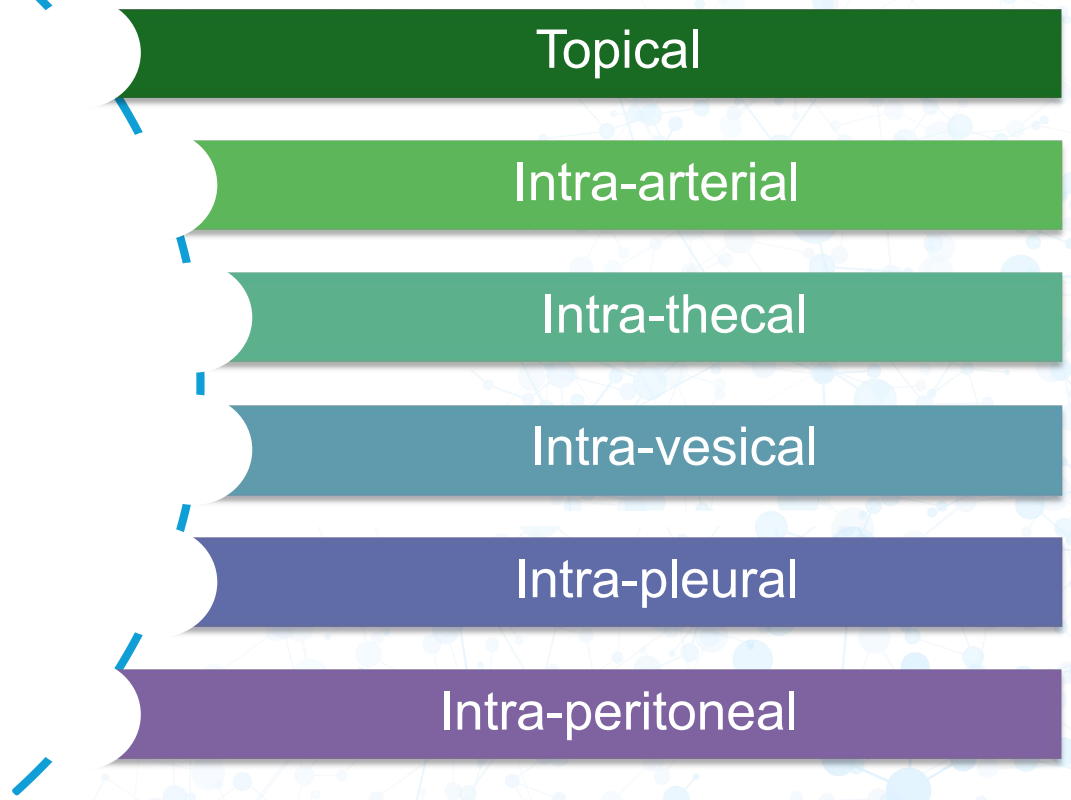
- **Advantage:**
  - Easy to administer

- **Disadvantage:**
  - Potential infection or bleeding



Regional Administration

- High doses of chemo drugs are given to a specific area of the body.
- Directs the chemo drugs to the body parts where the cancer is.
- Side effects still happen because chemo drugs will be absorbed to the blood streams.



Regional: Topical

- Apply cytotoxic agents on cutaneous malignant lesion

- Example:
  - 5-FU cream, apply OD /BD until lesion has progressed into the necrosis phase which take 1-3 weeks – desloughing to allow regranulation of tissues



Regional: Topical (Cont.)

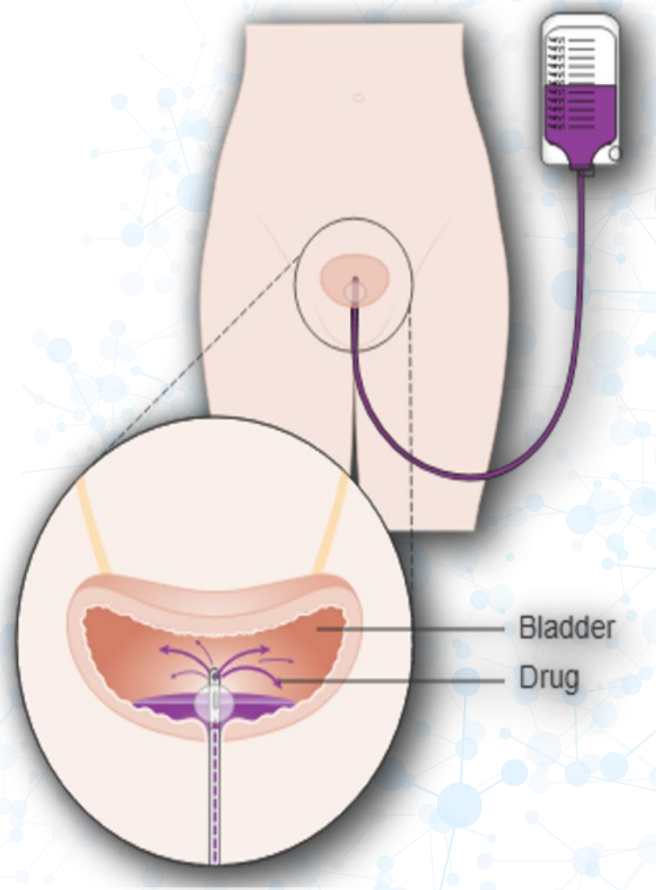
Administration



Figure 13. Cellular Kinetics

Regional: Intra – Vesical

- The drug infused into the bladder through a catheter into the urethra
  - (kill cancer cells lining the bladder & reduce recurrence after surgery TURBT) - early Cancer
- Example: Mitomycin, Doxorubicin
- Nursing responsibilities:
  - Clamp CBD
  - Change position every 15 minutes to ensure even contact

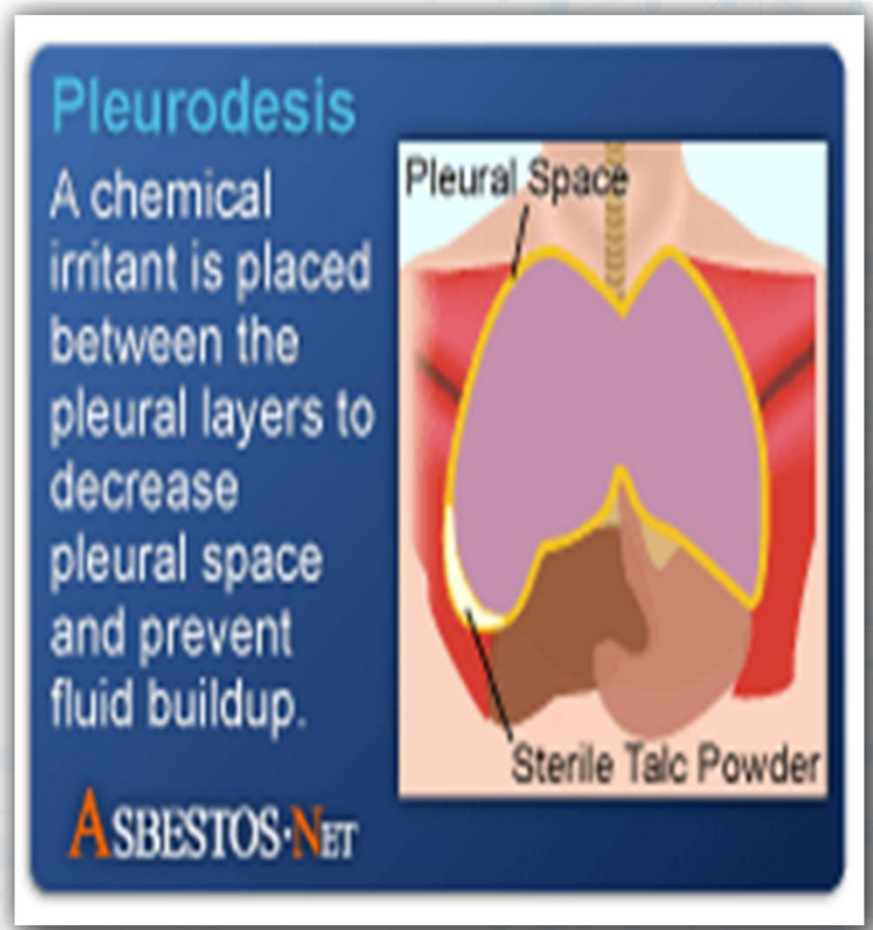


Regional: Intra – Vesical (Cont.)

Advantage	Disadvantage
• Direct exposure of bladder surface to drug.	• Requires insertion of Foley catheter. • Potential complication of UTI.

Regional: Intra – Pleural

- The drug infused into the chest cavity between the lung and chest wall.
- Mesothelioma (cancer that develops in the lining of the lung) and the lung or breast cancers that have spread to the pleura.
- Example: Bleomycin

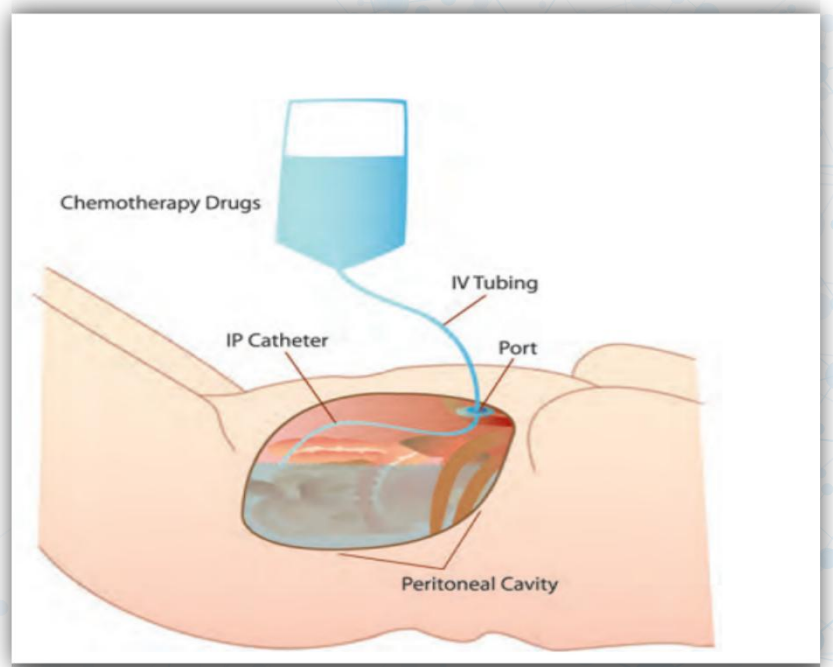


Regional: Intra – Pleural (Cont.)

Advantage	Disadvantage
• Sclerosing of pleural lining to prevent recurrence of effusions.	• Required surgical procedure for equipment placement. • Potential bleeding / embolism.

Regional: Intraperitoneal Chemotherapy

- Treatment for ovarian CA, which often spreads into the abdominal cavity.
- This chemotherapy technique delivers chemo drug directly into the abdominal cavity through implantable port or external suprapubic catheter (Tenckhoff cath).
- Example: Cisplatin, Paclitaxel, Mitomycin, Oxaliplatin, Docetaxel.



Regional: Intraperitoneal Chemotherapy (Cont.)

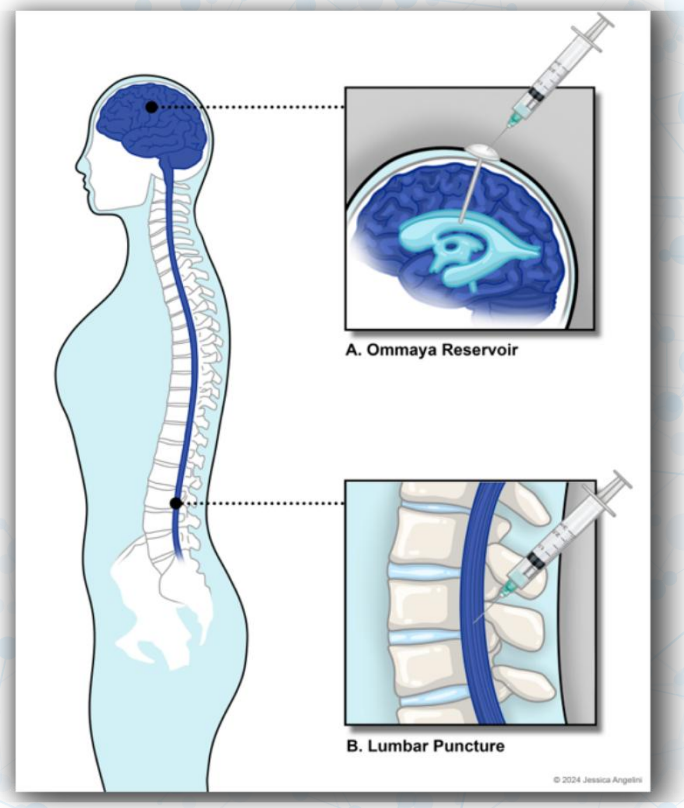
Advantage	Disadvantage
• Direct exposure of intra abdominal metastases to drug.	• Requires placement of Tenckhoff cat. Or intraperitoneal port. • Potential abdominal pain, distension, infection.

Regional: Intra - Thecal

- Chemo drugs are given directly into the Cerebro spinal fluid surrounding the brain and spinal cord.
- The medication should be injected slowly and maintain sterile technique throughout the procedure (15mls or less).
- Monitor the patient closely for potential neurotoxicity.

Example:

- Cytarabine, Methotrexate (Hematology Cancer)



Regional: Intra – Thecal (Cont.)

Advantage	Disadvantage
• More consistent drug levels in CSF.	• Requires LP or surgical placement of reservoir or implanted pump for drug delivery. • Potential complication of headache, confusion, lethargy, seizures.

Systemic Therapy

Chemotherapy:
Chemotherapy Calculation

Chemotherapy Calculation

The body surface area (BSA)

BSA is a better indicator of metabolic mass than body weight because it is less affected by abnormal adipose mass.

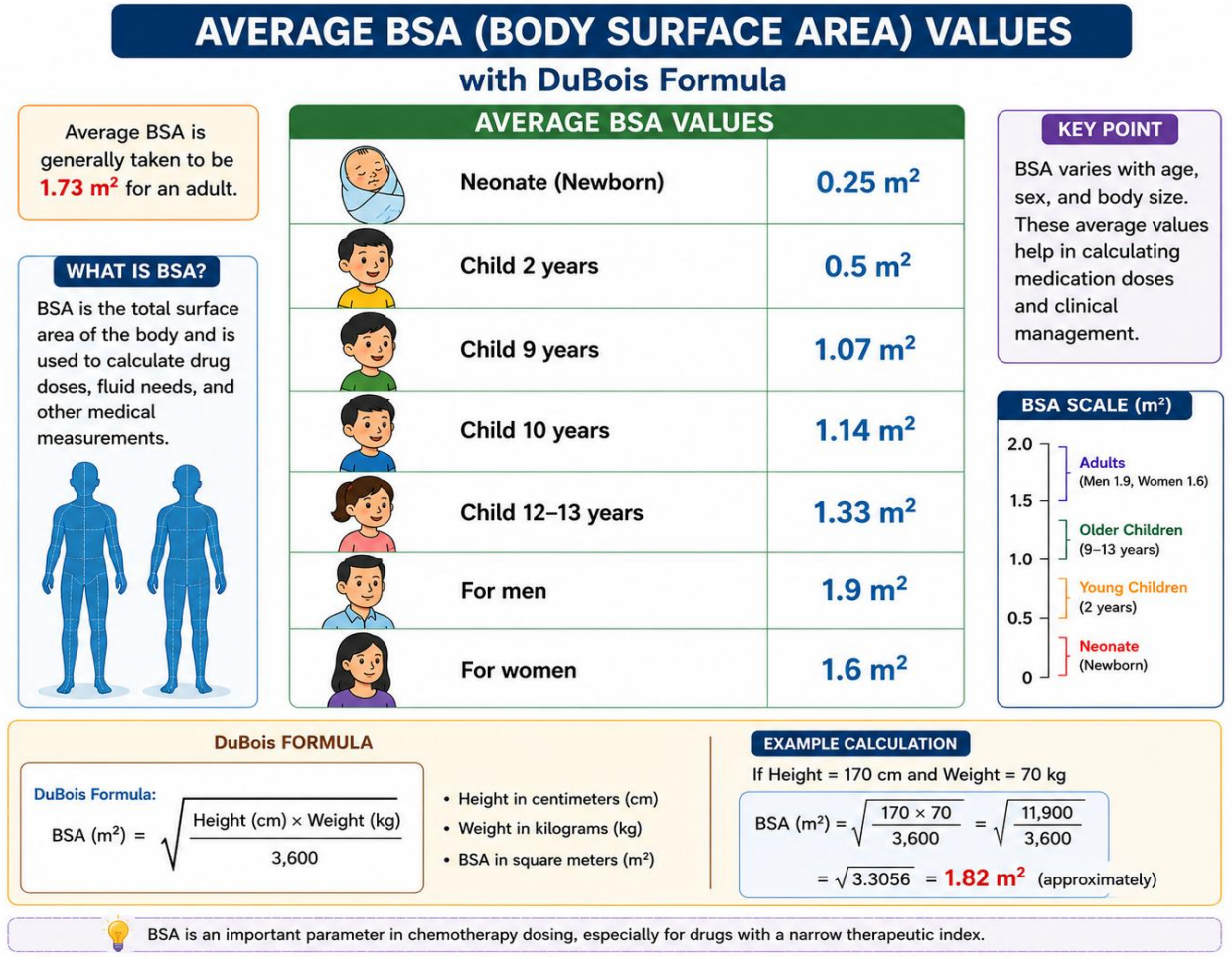


Figure 14. Body Surface Area

Systemic Therapy

Chemotherapy:
Chemotherapy Preparation

Process of Chemotherapy Preparation

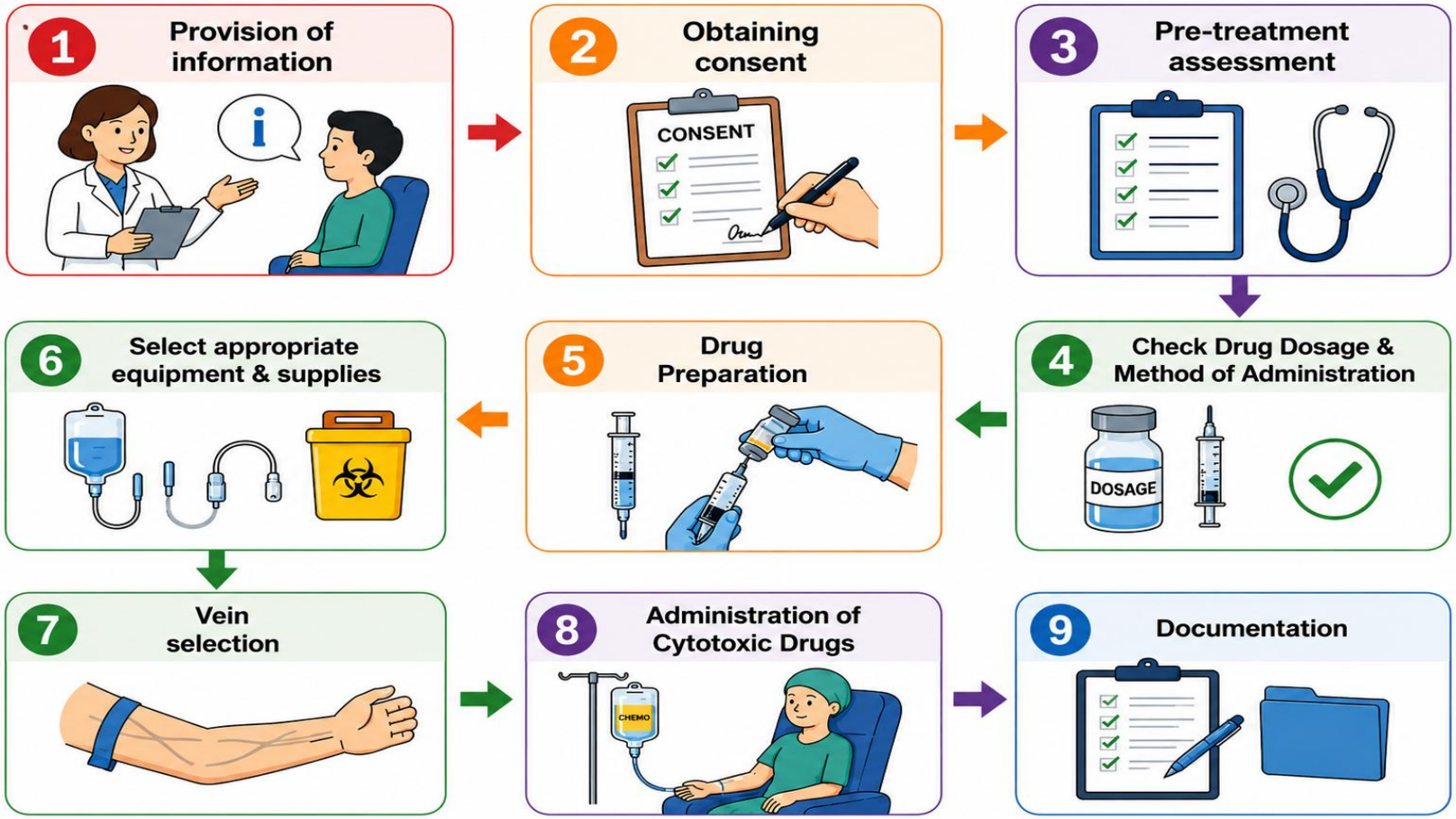


Figure 15. Summary of Chemotherapy Preparation

1. Provision Information

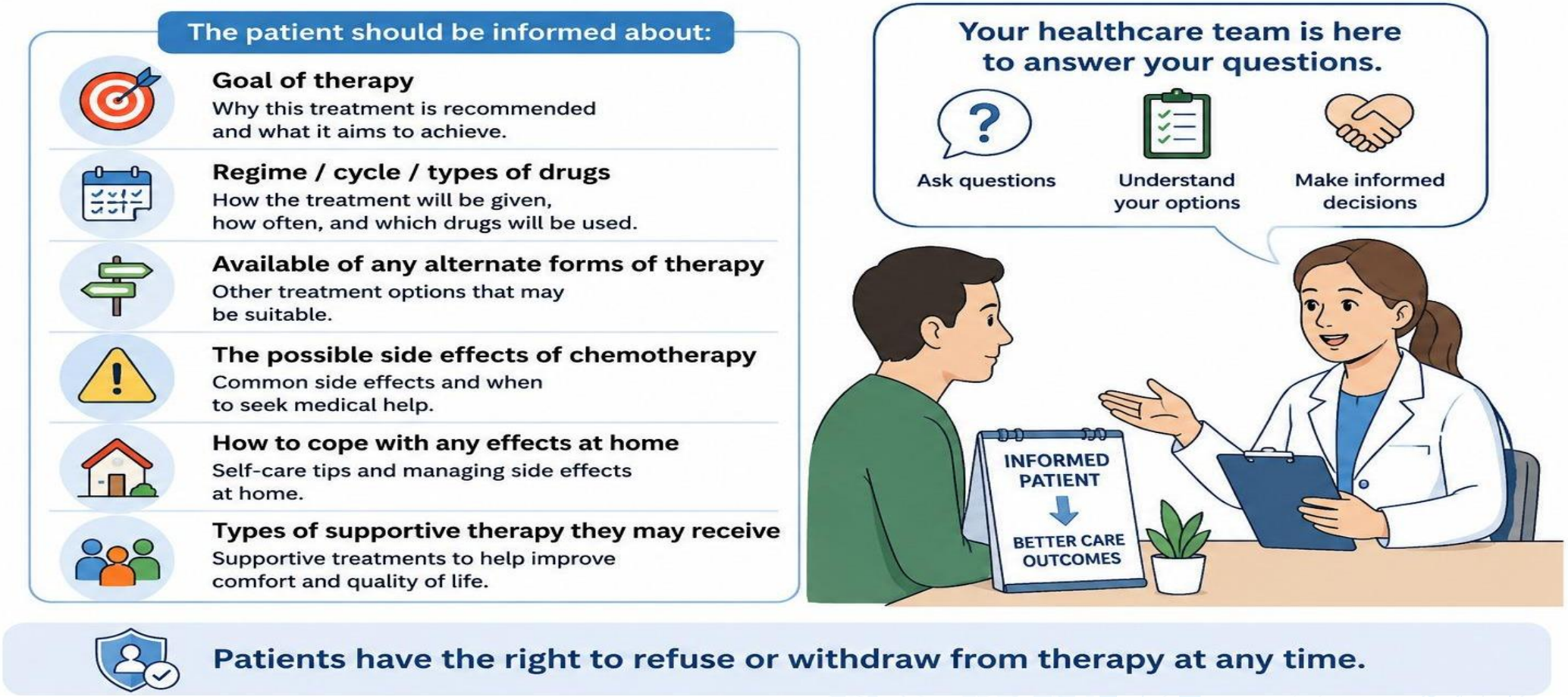


Figure 16. Provision Information

2. Obtaining Consent

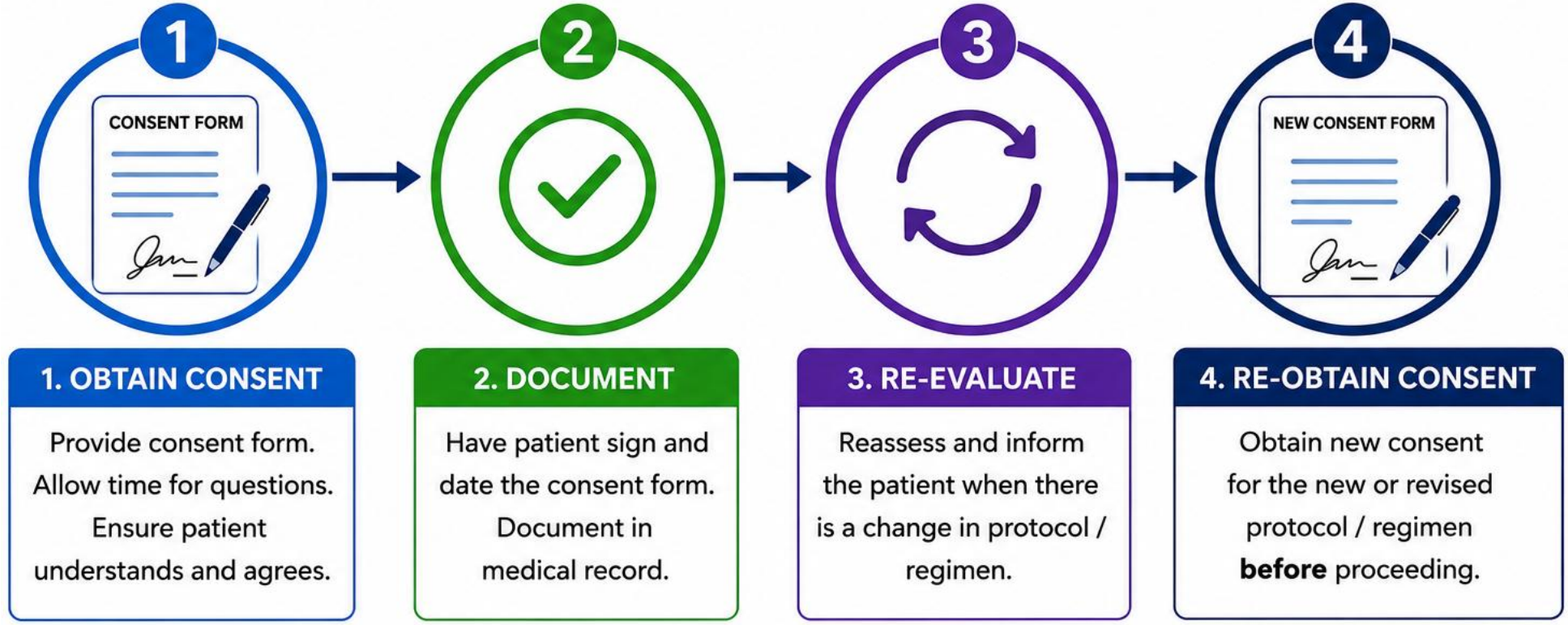


Figure 17. Obtaining Consent

3. Pre – Treatment Assessment

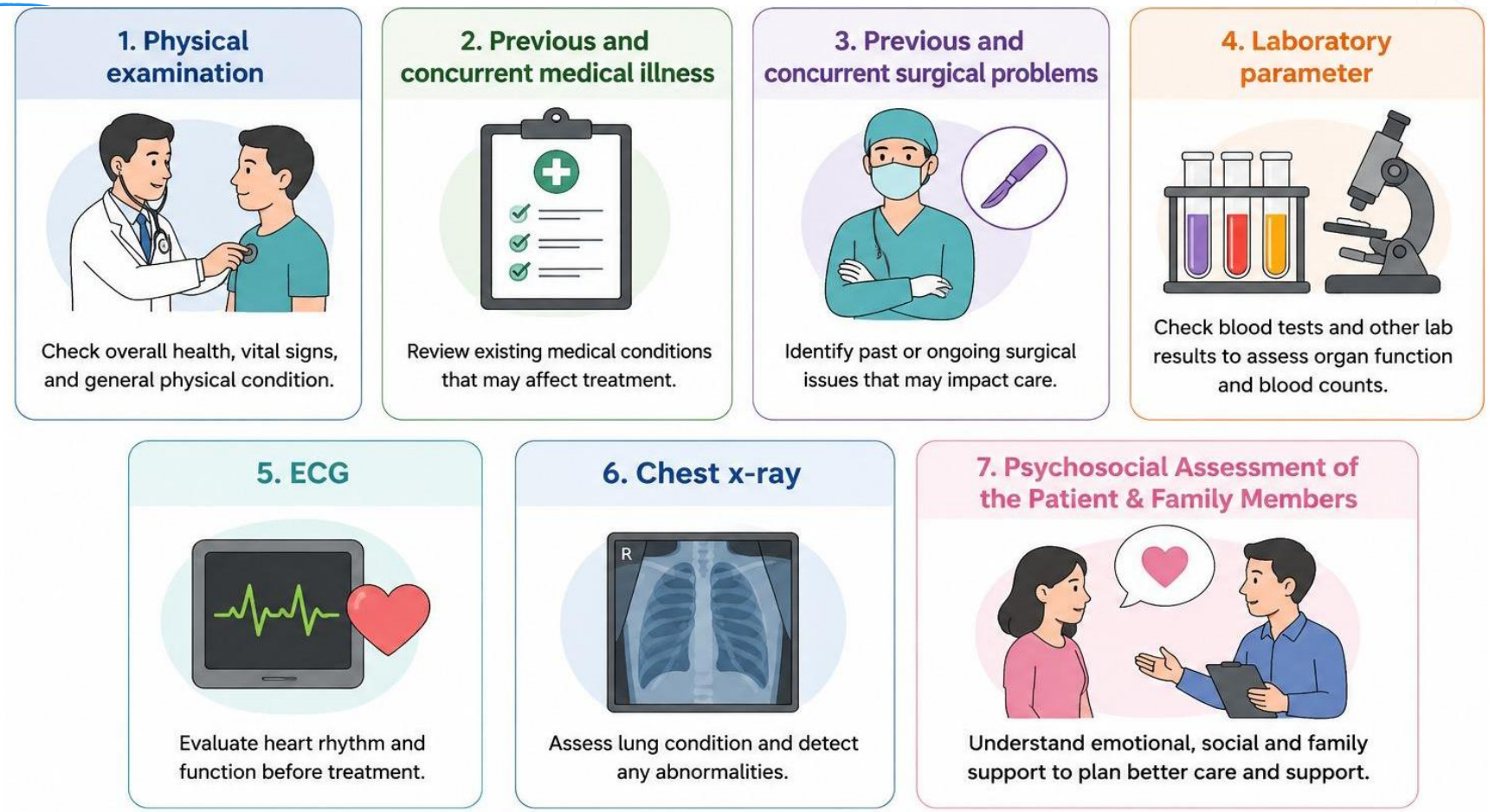


Figure 18. Pre – Treatment Assessment

4. Verification Drug Dosage and Route of Administration

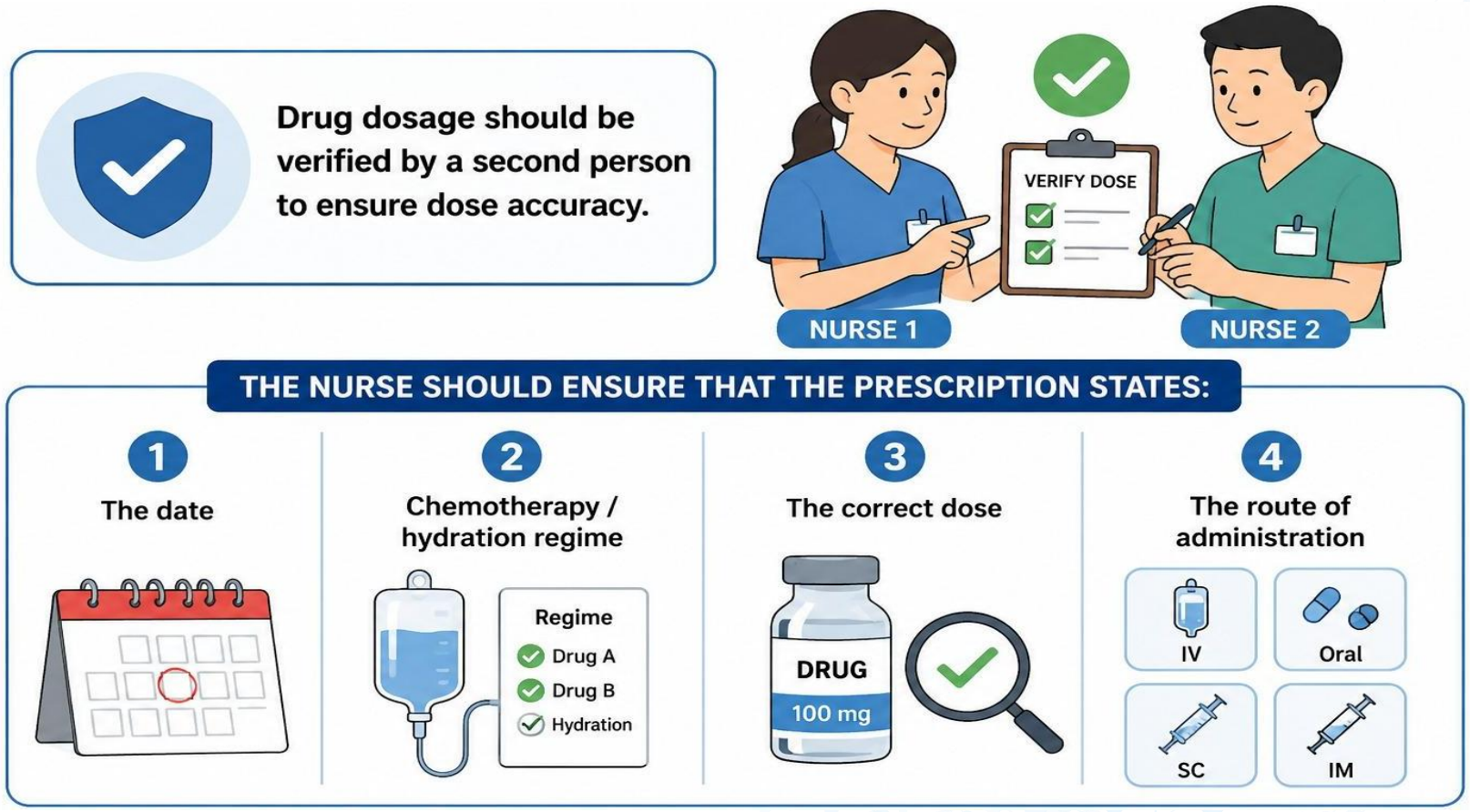


Figure 19. Verification Drug Dosage and Route of Administration

5. Drug Preparation

1 Pharmacy staff should reconstitute all drugs under a **biologic safety cabinet.**



Protects staff, patient and the environment from exposure.

2 When the drugs are prepared and reconstituted, **aseptic technique** must be used (follow safe handling guidelines) and prepare in a special room with no interruption.

ASEPTIC TECHNIQUE



- Hand hygiene
- Sterile gloves
- Use sterile equipment
- Work carefully to keep clean

SPECIAL ROOM



Prepare in a room with no interruption.

Figure 20. Drug Preparation

6. Select Appropriate Equipment and Supplies

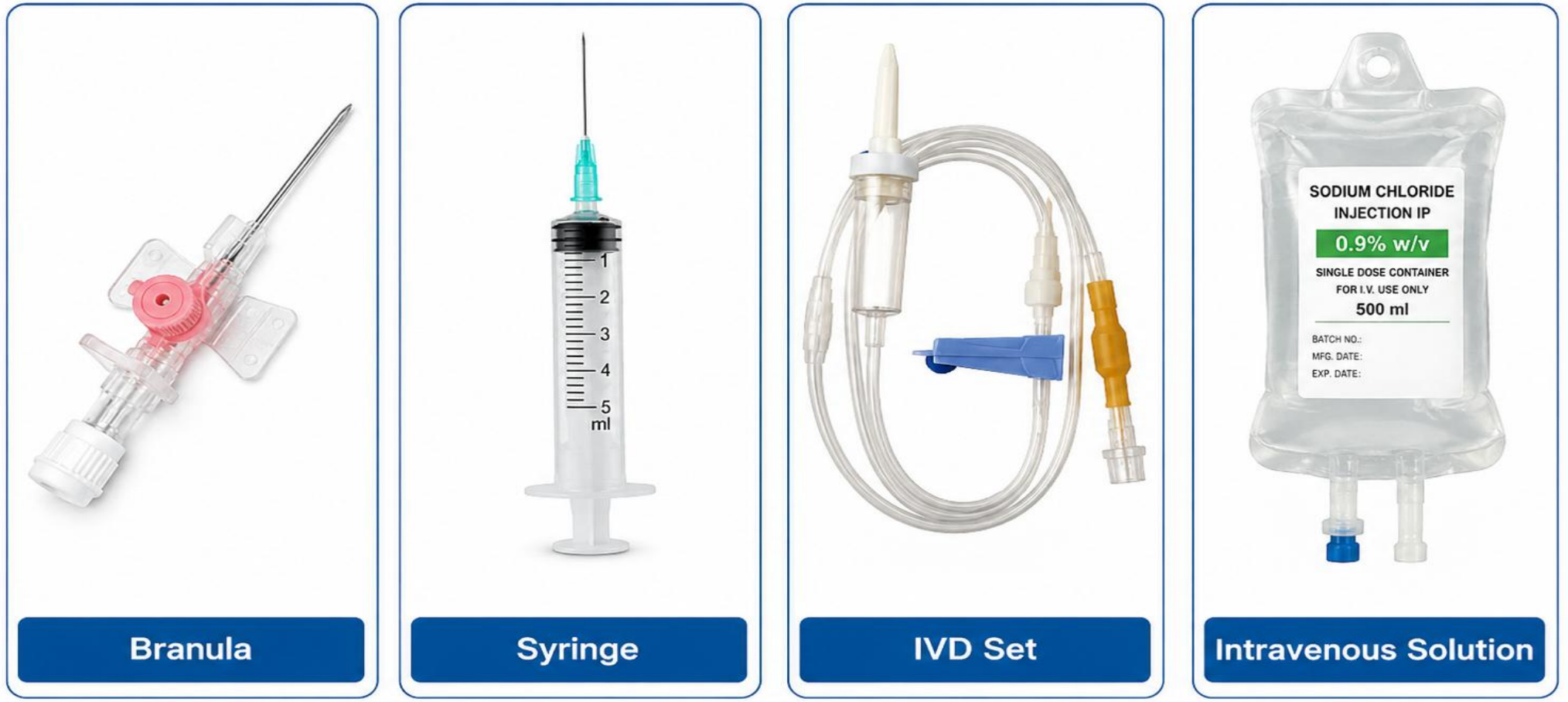


Figure 21. Select Appropriate Equipment and Supplies

7. Vein Selection

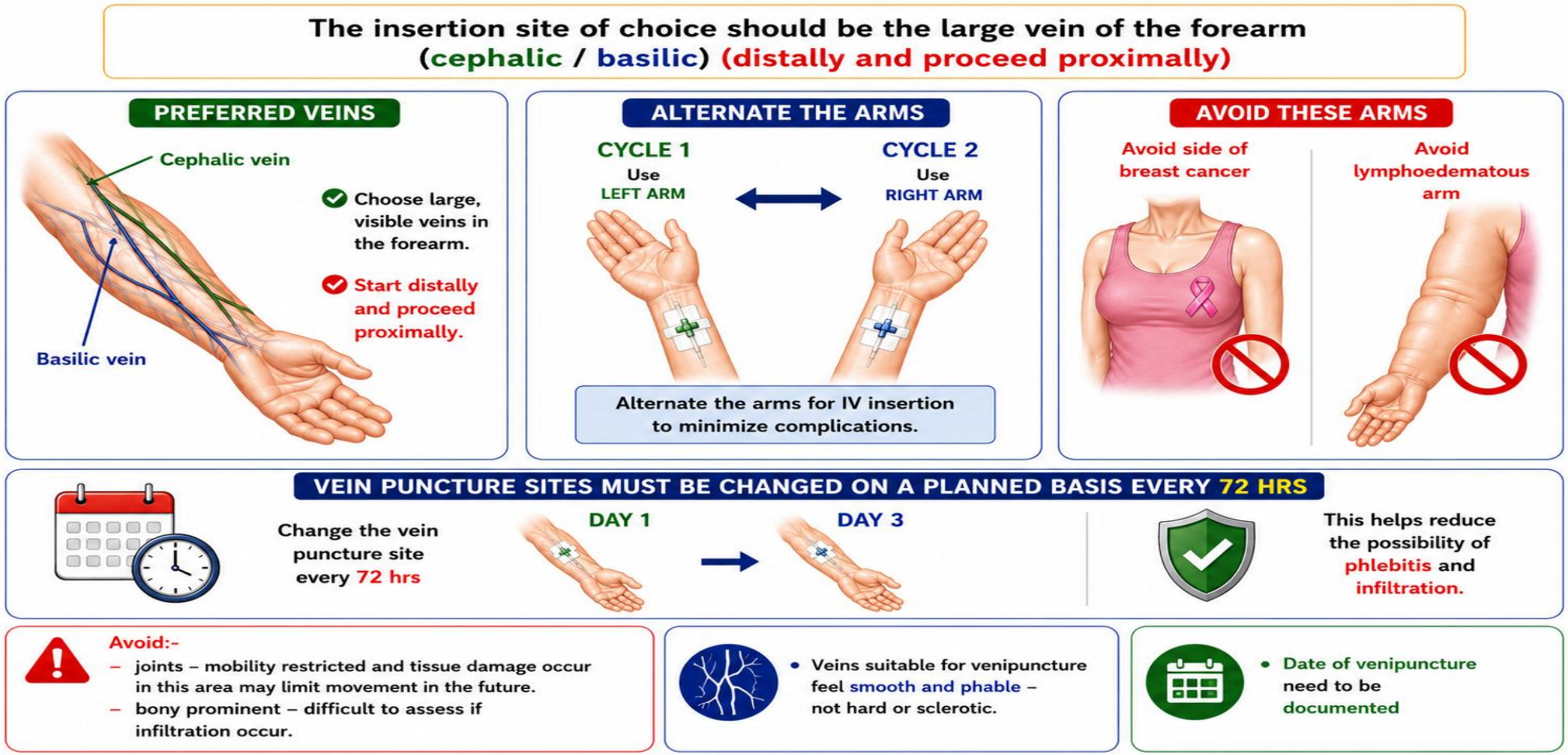


Figure 22. Vein Selection

8. Administration of Cytotoxic Drugs



Figure 23. Administration of Cytotoxic Drugs (Before)

8. Administration of Cytotoxic Drugs (Cont.)

DURING:

1 Administer drugs in a safe, unhurried environment.



2 Place a plastic absorbent pad under the tubing – catch any leakage.



3 Administer chemo drugs in the correct order:

ANTIEMETIC → VESICANT FIRST → NON-IRRITANT → IRRITANT

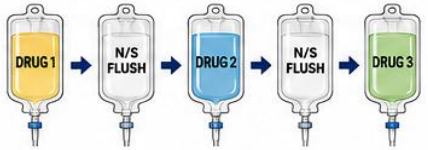
4 Testing vein patency without using chemotherapeutic agents.



5 Avoid using 'brannula pots'.



6 If more than one drug to be given flush with N/S in between each drug to avoid incompatibility.



7 If multiple drugs to give vesicant agent should be given first follow by non-irritant agent and lastly irritant agent.

VESICANT FIRST → NON-IRRITANT SECOND → IRRITANT LAST

8 Cytotoxic drugs must be given in a slow and steady pressure – e.g. 1 mL / 1 minute.



Figure 24. Administration of Cytotoxic (During)

8. Administration of Cytotoxic Drugs (Cont.)

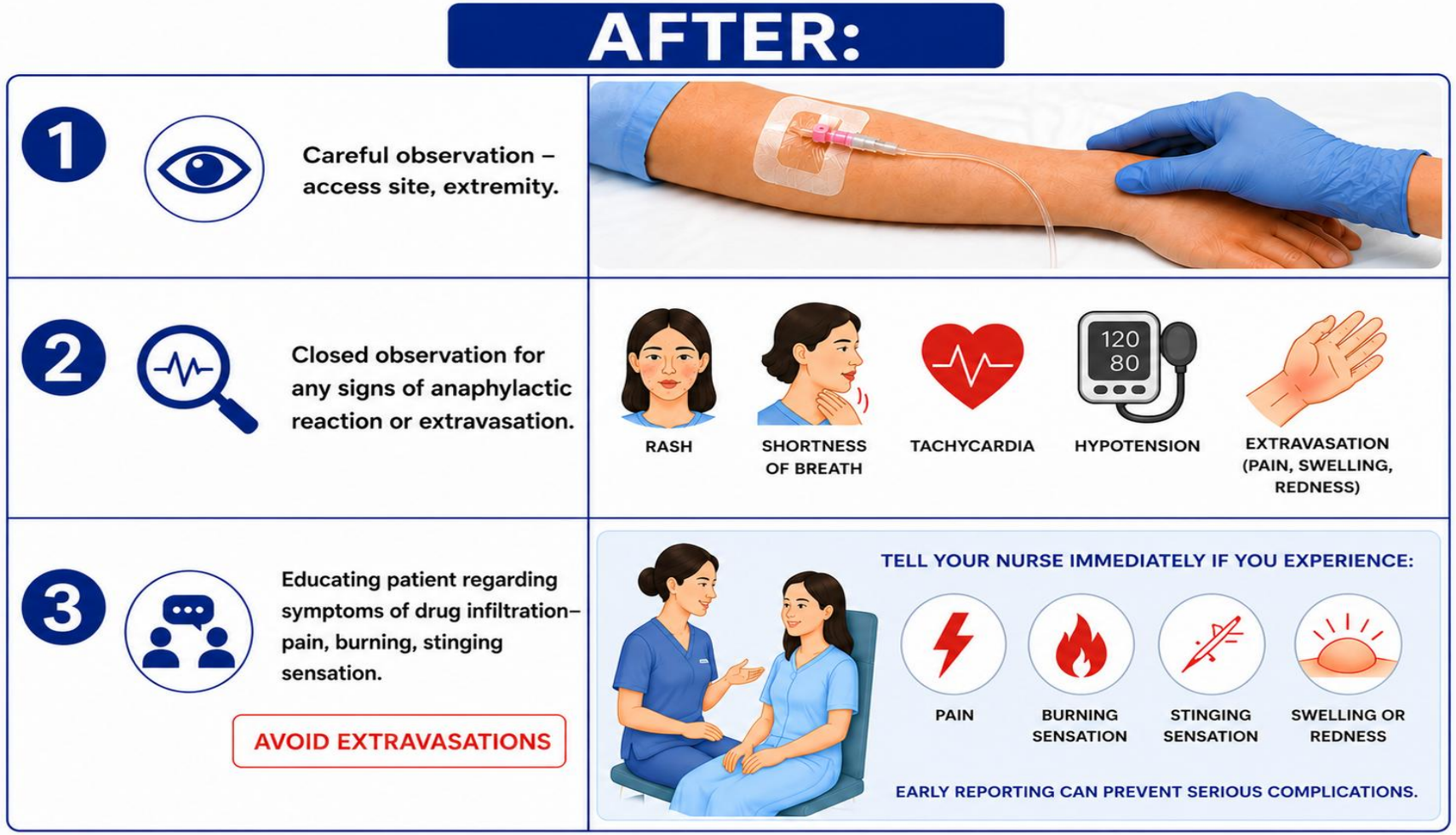


Figure 25. Administration of Cytotoxic (After)

9. Documentation



Figure 25. Documentation

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THANK YOU