Cancer Treatment

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Objectives

- Compare modalities of cancer treatment
- Describe advantages of one treatment modality over another for specific types of cancer
- Identify the nurse's role in cancer treatment

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Treatment Approaches

- Goal:
  - Prevention
  - Cure
  - Control
  - Palliation

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National Cancer Institute Types of Cancer Treatment

	Surgery	Radiation Therapy	Stem Cell Transplantation	Chemotherapy	Targeted Therapy	Immunotherapy
Description	Local therapy, oldest type of cancer treatment. Primary treatment for solid tumors.	Usually local therapy, one of the earliest types of therapy. Ability to focus in on treatment area.	Use of high dose chemo and radiation therapy to eradicate disease. Stem cells are infused to replace or rebuild the bone marrow and rescue the patient from severe SE's.	Usually systemic therapy, may be regional. Drugs given via multiple routes.	Systemic therapy. Drugs that target select molecular pathways to disrupt cancer cell reproduction. Focus on oral agents.	Usually systemic therapy using the patient's immune system to kill cancer cells.
Types	Diagnosis Curative Preventative Palliative Restorative Emergency	External beam Proton therapy Neutron therapy Brachytherapy Radiopharmaceuticals	Autologous – self as donor Allogeneic – other donor • Matched sibling • Identical twin • Partially matched family member • Matched unrelated donor	Cell-cycle specific Cell-cycle nonspecific Alkylating agents Antimetabolites Antitumor antibiotics Miscellaneous Nitrosoureas Plant alkaloids	Oral antineoplastics - Small molecule inhibitors TKI's RTKs mTOR Proteasome inhibitors PARP Inhibitors CDK4/6	Cytokines Monoclonal antibodies Checkpoint inhibitors CAR T-Cell Immunotherapy Adoptive cellular therapy Oncolytic viral therapy
Approaches	Open resection Laparoscopic Robotic Endoscopic Laser Ablative	IMRT, IGRT Megavoltage external beam Stereotactic radiosurgery Proton Therapy SRT, SBRT Cyberknife	Bone marrow Peripheral Blood Stem Cells Umbilical Cord Blood	Single-agent chemo Combination chemo Neoadjuvant Adjuvant High dose Dose dense	Oral therapies Requires extensive patient and family education Adherence important issue	Checkpoint inhibitors and monoclonal antibodies are infused via IV route. Cytokines are given sq or infused.
Treatment details	Physical exam Interventional radiology Safety and management Postanesthesia recovery	Radiobiology Fractionation Treatment planning Simulation Positioning Dose administration Radiation safety	Cell collection Cryopreservation Conditioning (high-dose treatment) Marrow aplasia Engraftment Recovery	Administration safety Dose calculation Dose verification Patient education Safe handling of hazardous drugs	Drug interactions Comorbidities Symptom management	Specific training, facilities, procedures are required for CAR T-Cell Immunotherapy, adoptive cellular therapy and oncolytic viral therapy.
Notable side effects or complic-ations	Safety procedures and communication required around OR environment. Monitor patient status pre- and post-op. Preventative measures for lungs and VTE prophylaxis.	Skin changes – erythema, dry desquamation, moist desquamation, pruritis, hyperpigmentation, alopecia Fatigue Site-specific side effects – due to damage in the radiation field	Infection Bone marrow suppression Hepatic sinusoidal obstruction syndrome Organ toxicity Mucositis Idiopathic pulmonary interstitial pneumonitis Graft vs. Host Disease	Bone marrow suppression, GI toxicities, cardiac, pulmonary, hepatic, genitourinary, sexual and reproductive, cutaneous, endocrine, fatigue, neurological, ocular	EGFRI Skin reactions Cardiac toxicities Fluid retention Mucositis Diarrhea	Immune-related adverse events Infusion reactions Skin rash Hepatic toxicity Fatigue Pneumonitis GI toxicity

Sources: Brant, 2020; Eggert et al., 2022; McQuestion et al, 2021; Olsen et al, 2023; Yarbro et al, 2018.

Image courtesy of the National Cancer Institute

Surgery

Surgery - Principles

- Primary treatment for most solid tumors
- Surgical Team
- Define
  - Goal of surgery
  - Functional importance of involved organ or structure
  - Ability to restore function
  - Patient status and ability to undergo procedure

(Davidson, 2020)

Types of Surgery

- Preventative
- Diagnostic
- Curative
- Palliative
- Restorative
- Emergency

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(Davidson, 2020; Lester, 2018; Parks, 2022)

Surgical Approaches

- Open resection
  - Tumor margins
  - Sentinel lymph node biopsy
- Laparoscopic
- Robotic
- Endoscopic
- Laser
- Ablative

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(Davidson, 2020; Lester, 2018)

Nursing Care Considerations

- Pre-operative
  - ERAS
  - Prehabilitation
- Perioperative
- Post-operative

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(Davidson, 2020; Lester, 2018; Parks, 2022)

Image courtesy of the National Cancer Institute

Radiation Therapy

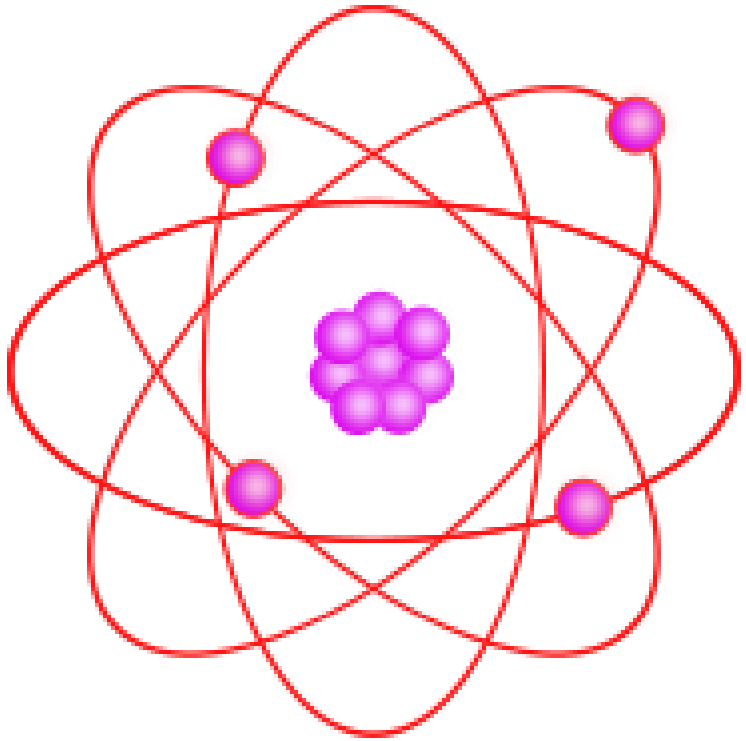
Radiation Oncology Team

- Radiation oncology nurse
- Radiation oncologist
- Radiation therapists
- Medical physicists and dosimetrists
- Mold and cast technicians
- Medical engineers
- Administrators
- Social workers

(Behrend, 2020)

Radiation Therapy

- Atoms



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(Behrend, 2020; Gosselin, 2018; Pierce & Shaftic, 2022)

Ionizing Radiation in Radiation Therapy

External Beam Radiation Therapy Used in multiple cancer types, most common type of radiation therapy Megavolt machines	Linear Accelerator	X-Ray Electron particles
	Cobalt-60 Sealted Source	Gamma rays
	Large Particle Machines Cyclotron	Neutrons Protons
Brachytherapy Radioactive therapy applied directly to the tumor site	Sealed Sources Seeds – prostate Tandem and rings – cervical	Beta particles Gamma rays
Radiopharmaceutical Therapy Radioactive therapy taken by pill – systemic therapy	Unsealed Sources Iodine-131 for thyroid cancer	Beta particles Gamma rays
Specialized Treatment Machines	Stereotactic radiosurgery (SRS) Stereotactic radiotherapy (SRT) Stereoteactic body radiation therapy (SBRT) Cyberknife	

(Gosselin, 2018; Behrend, 2020; Table adapted from Iwamoto et al., 2012, p.17)

Radiobiology

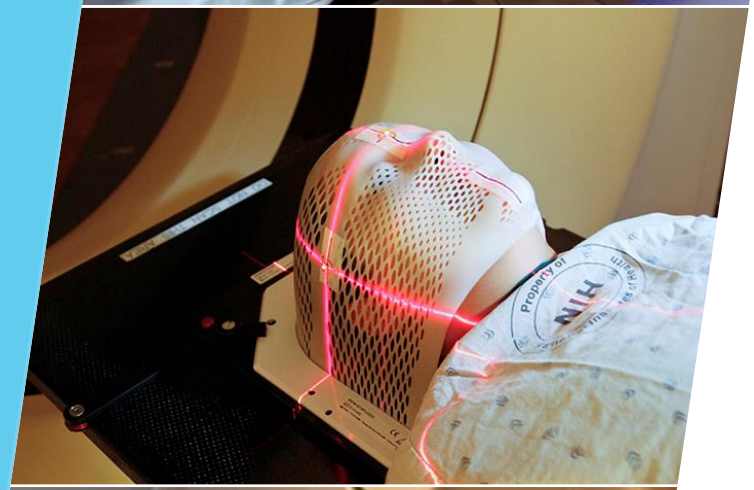
- Oxygen effect – RT works better in well oxygenated tumors
- Linear energy transfer – rate for energy to pass through matter
- Relative biological effectiveness – comparison of test radiation to reference dose
- Dose rate – the rate treatment is given from a machine

(Behrend, 2020; Gosselin, 2018)

Fractionation

- Repair – healthy cells repair between fractions but cancer cells cannot
- Reassortment/redistribution – cancer cells are forced into cell cycle and more vulnerable to damage
- Repopulation of normal cells takes place between fractions
- Reoxygenation occurs as the tumor shrinks, improving oxygen to site and the radiation effect improves
- Radiosensitizing – radiation is more effective on cells that are undifferentiated and actively in mitosis

(Behrend, 2020; Gosselin, 2018)



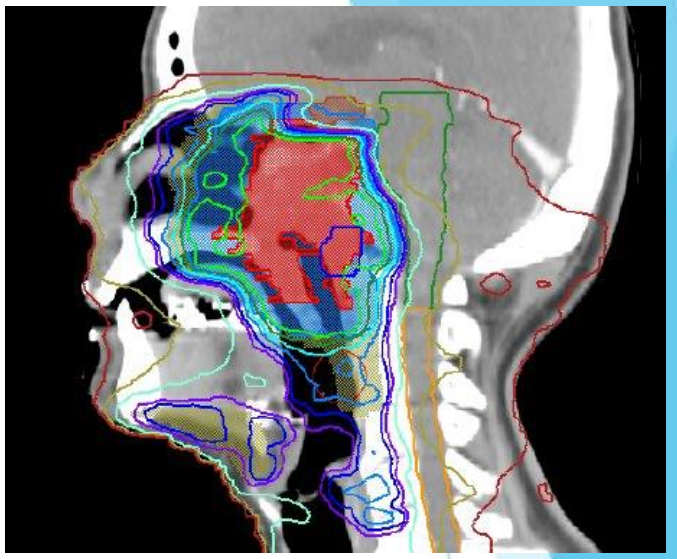
Treatment Delivery

- Treatment planning
- Imaging
- Simulation
- Positioning and immobilization
- 1 rad = 1/100 Gy = 1 cGy

(Behrend, 2020)

Treatment Delivery

- Intensity Modulated Radiation Therapy (IMRT)
- Image-Guided Radiation Therapy (IGRT)
- Brachytherapy



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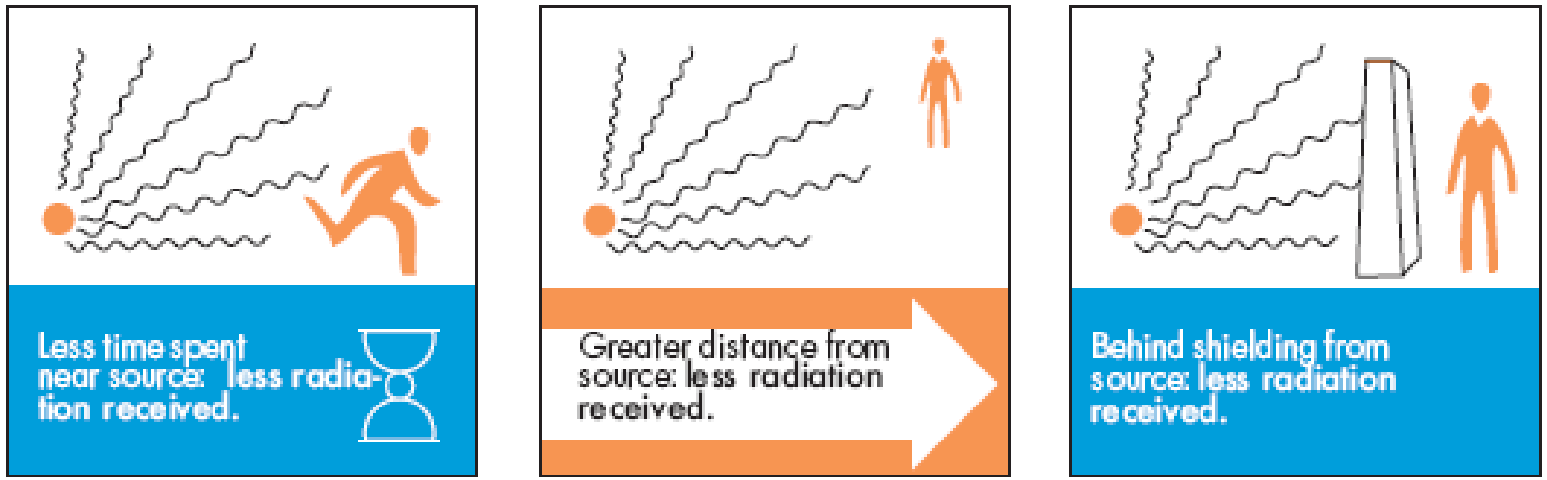
(Behrend, 2020; Images courtesy of Hollis Cancer Center, Lakeland, FL)

Radiation safety

- ALARA – As low as reasonably achievable
- Radiation Safety Officer



(Behrend, 2020; Image courtesy of nrc.gov)

Radiation Toxicity

Skin changes

- Erythema
- Dry desquamation
- Moist desquamation
- Pruritis
- Hyperpigmentation
- Alopecia

- Fatigue
- Site-specific side effects
  - Head and neck
  - Abdomen
  - Pelvis

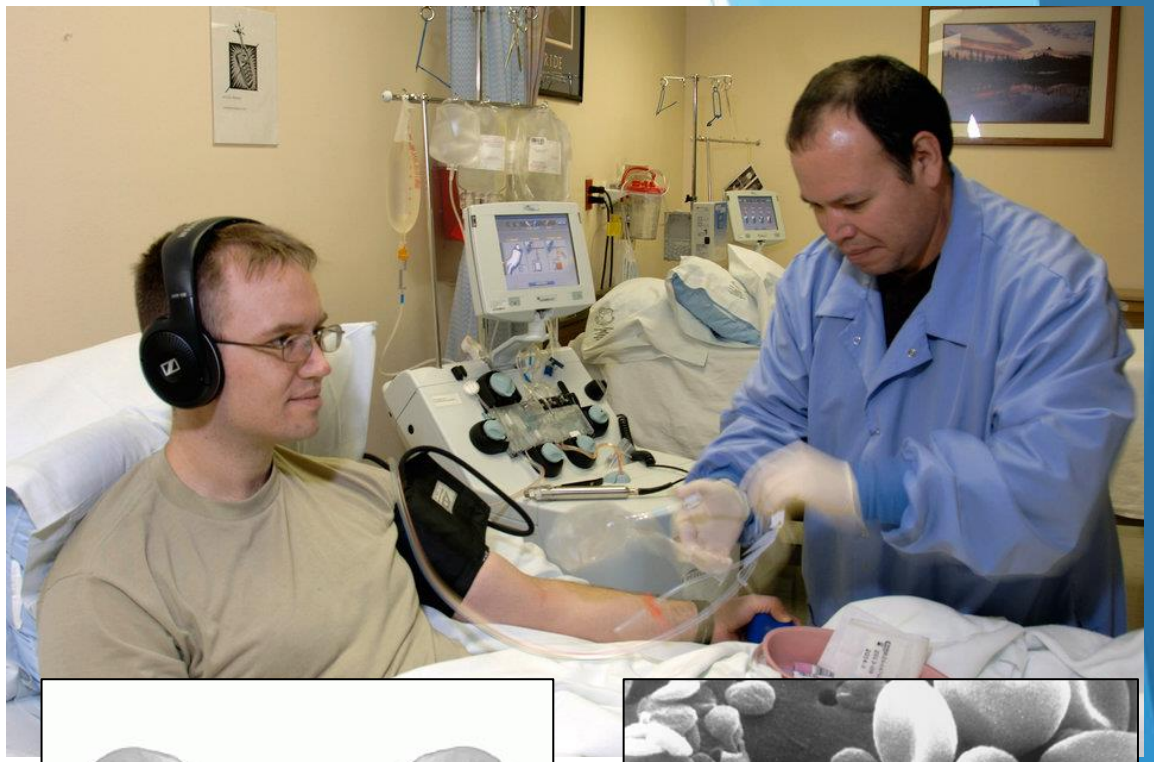
(Behrend, 2020)

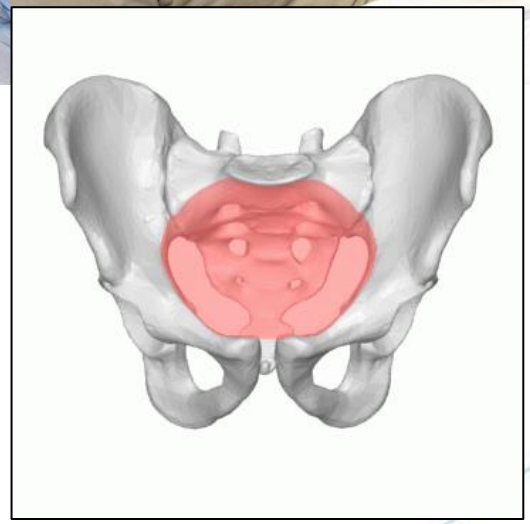
Hematopoietic Stem Cell Transplantation

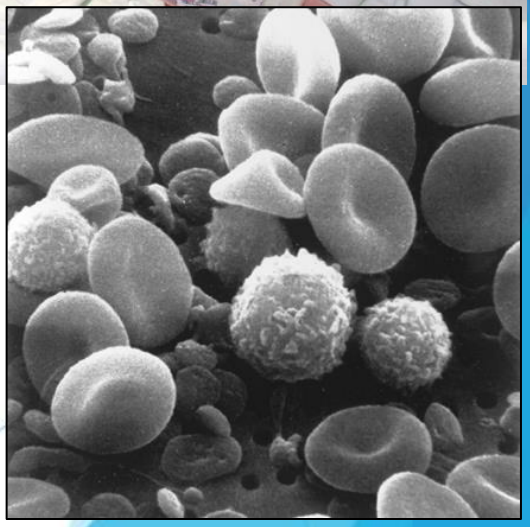
U.S. Navy photo by Photographer's Mate 2nd Class Chad McNeeley. / Public domain

Cell Sources

- Bone marrow (BM)
- Peripheral blood stem cells (PBSC)
- Umbilical cord blood (UCB)







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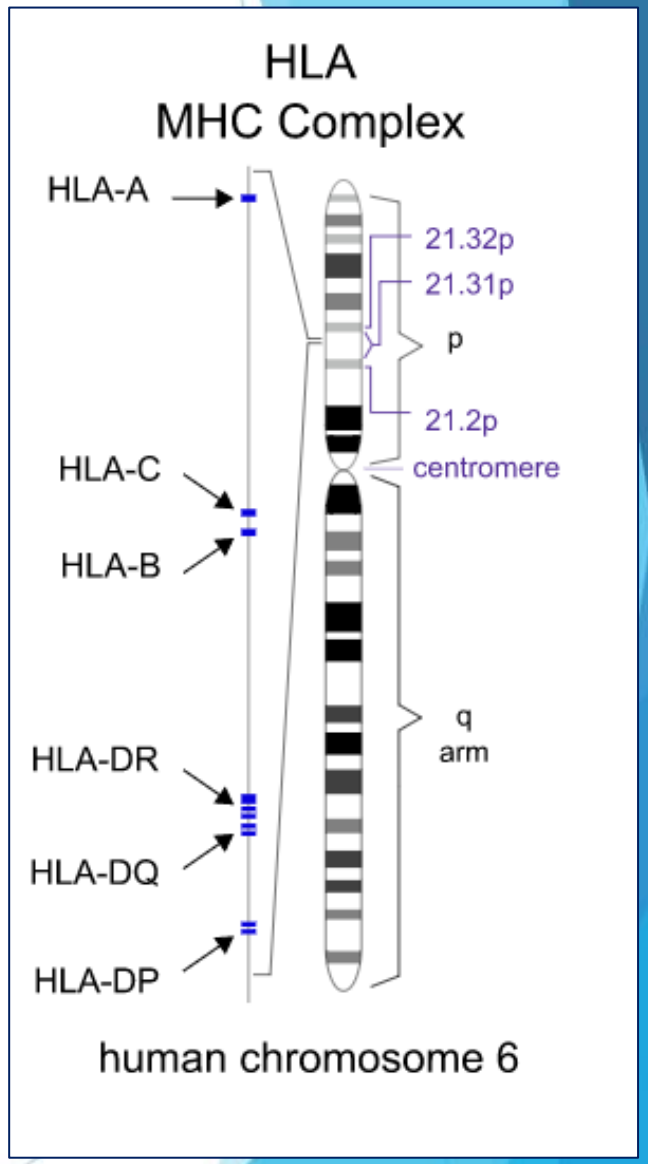
Hematopoietic Stem Cell Transplantation

- Patient Identification
- Pre-transplant workup
- Types
  - Autograft/autologous
  - Allograft/allogeneic

(Shapiro, 2020)

Hematopoietic Stem Cell Transplantation: Allogeneic

- Transplant product into genetically different recipient
  - Matched sibling donor – BM, PBSC, UCB
  - Identical twin donor – BM, PBSC
  - Partially matched family member – BM, PBSC, UCB
  - Matched unrelated donor – BM, PBSC, UCB



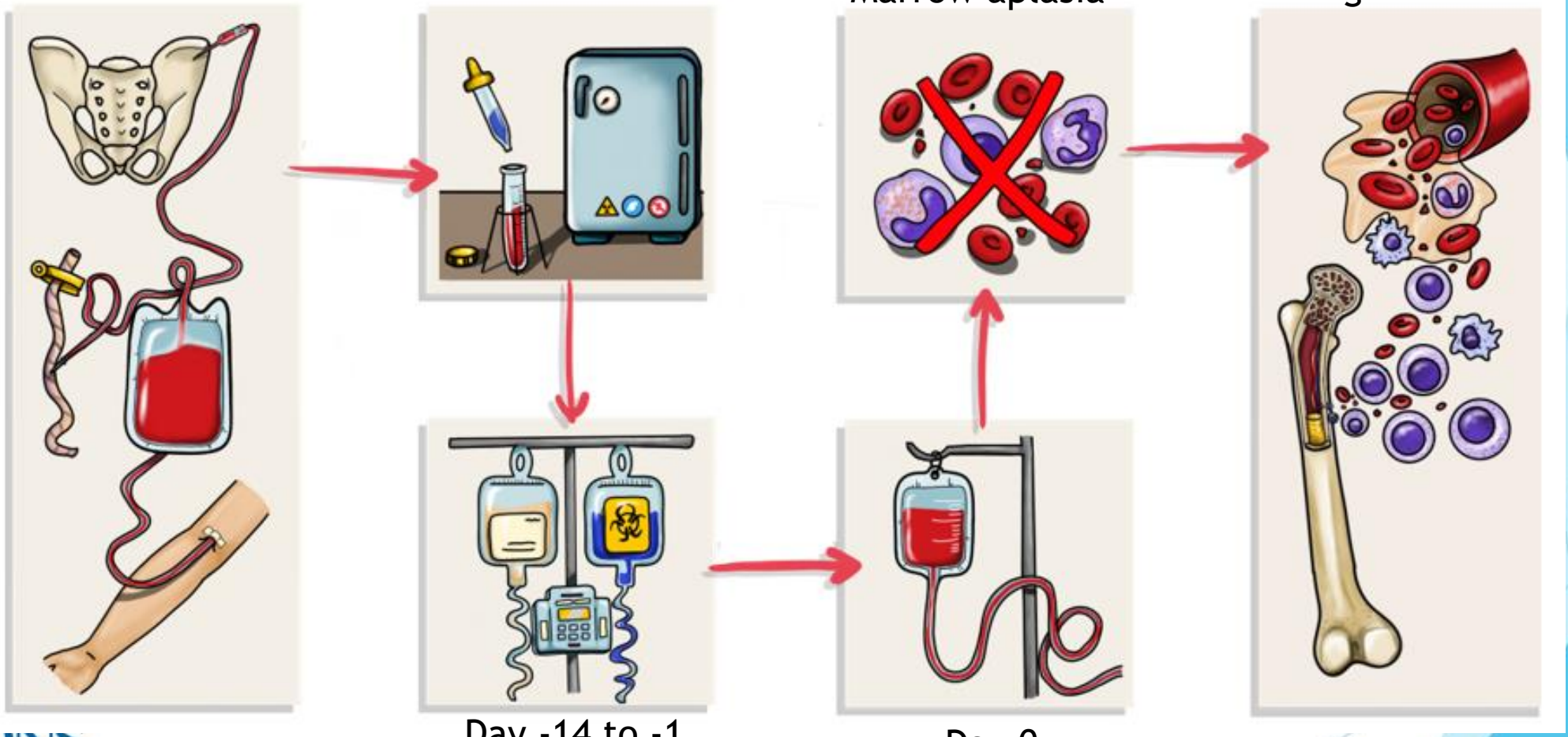
(Shapiro, 2020; HLA.jpg:Pdeitiker at en.wikipediaderivative work: Faigl.ladislav / Public domain)

Diseases Treated with Allografting

- Leukemia
- Myelodysplastic syndromes
- Immunodeficiencies
- Hematologic disorders
- Bone marrow failure
- Nonhematologic genetic disorders
- Lymphoproliferative disorders

(Shapiro, 2020)

Transplant Process



Transplantation Side Effects: Acute

- Bone marrow suppression
- Infection – bacterial, viral or fungal
- GI toxicity – Nausea, vomiting, mucositis
- Hepatic sinusoidal obstruction syndrome or veno-occlusive disease (VOD)
- Organ toxicity
- Idiopathic pulmonary interstitial pneumonitis
- Graft vs. Host Disease

(Shapiro, 2020)

Image courtesy of the National Cancer Institute

Chemotherapy

Approaches to Chemotherapy

- Single-agent chemo
- Combination chemo
- Adjuvant
- Neoadjuvant
- Concurrent
- Conditioning
- Systemic chemo
- Regional chemo
- High-dose chemo
- Dose density
- Dose intensity
- Relative dose intensity

(Davis & Howard, 2020; Olsen et al., 2023)

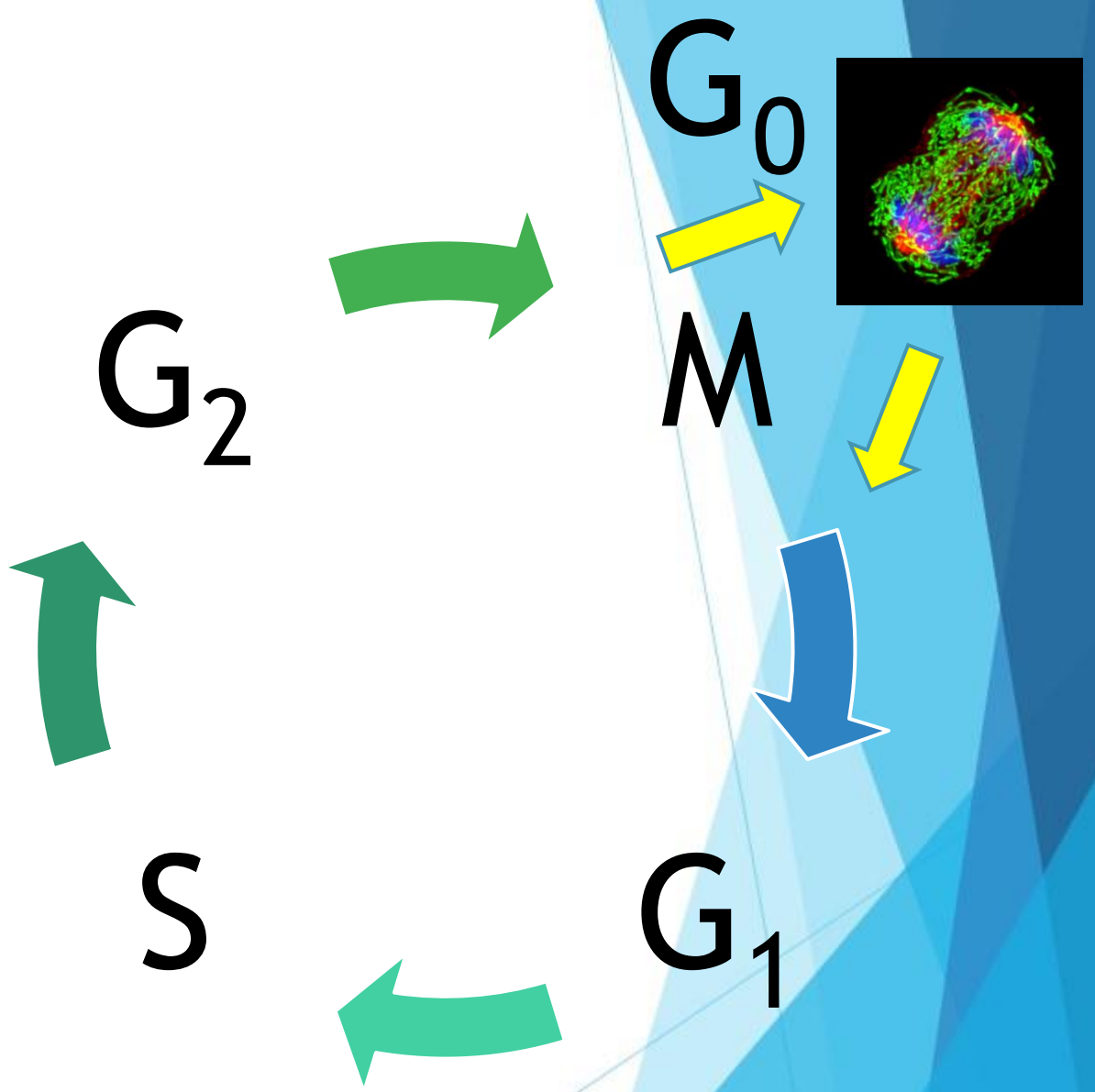
Factors influencing Response

- Tumor characteristics
- Patient characteristics
- Administration or schedule
- Route:
  - Oral
  - Subcutaneous or Intramuscular
  - Intravenous
  - Intrathecal or intraventricular
  - Intraperitoneal
  - Intravesical
  - Intra-arterial
  - Intrapleural

(Davis & Howard, 2020; Olsen et al., 2023)

Cell Cycle

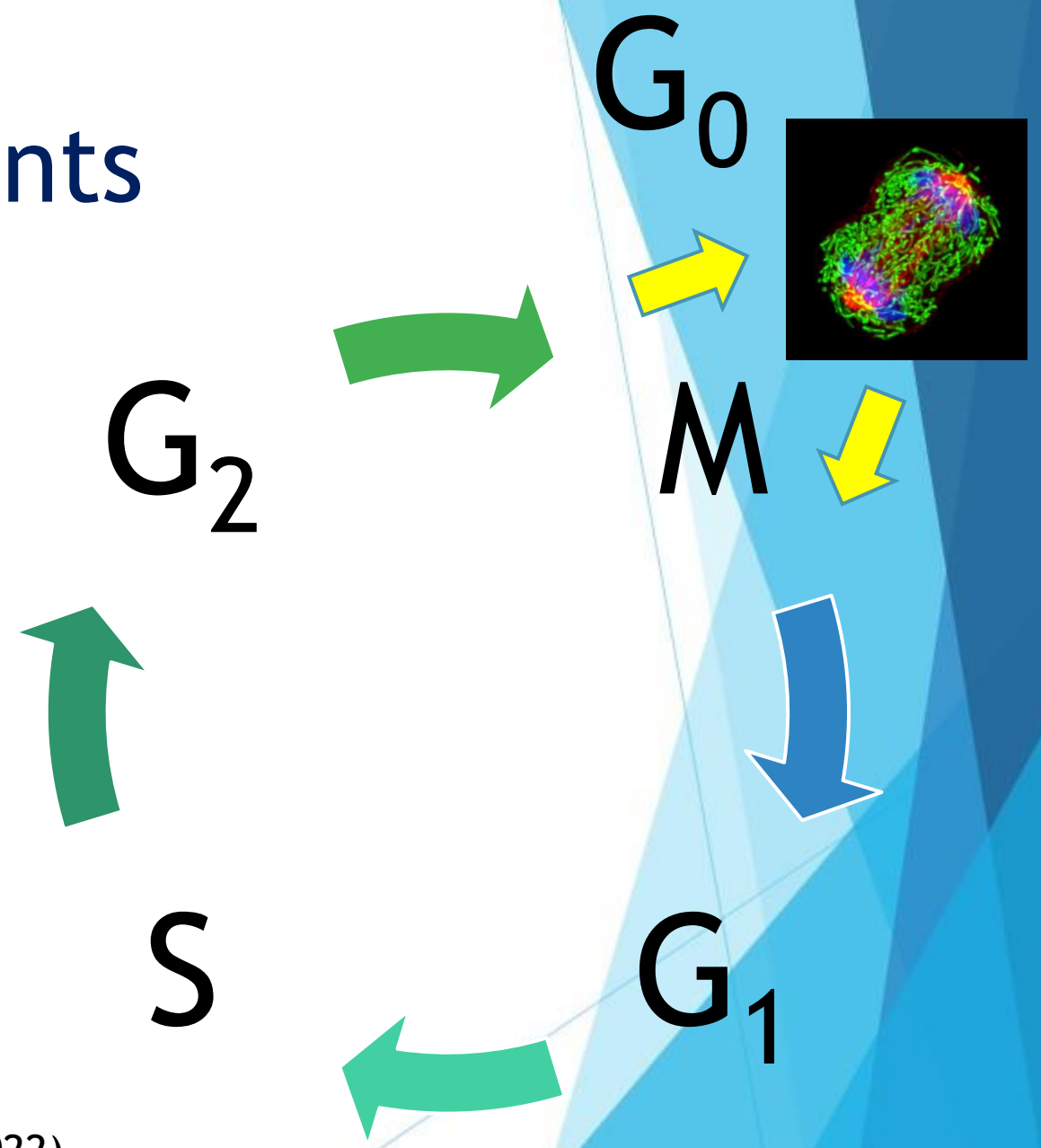
- G_1: Post-mitotic synthesis of RNA
- S: Synthesis of DNA
- G_2: Premitotic synthesis of protein
- M: Mitosis



(Olsen et al., 2023; Vlcek, 2022; Image courtesy of National Cancer Institute)

Cell Cycle Specific Agents

- S: Methotrexate, 5FU
- G_2: Irinotecan, doxorubicin, etoposide, bleo
- M: Taxanes



(Olsen et al., 2023; Vlcek, 2022)

Alkylating Agents

- Cell cycle non-specific
- Causes breaks in DNA strands leading to cell death
- Dose limiting toxicities
  - Bone marrow suppression
  - GI toxicities
  - Organ toxicity
  - Infertility
- Examples: busulfan, carboplatin, cisplatin, cyclophosphamide, oxaliplatin, thiotepa

(Olsen et al., 2023; Vlcek, 2022)

Antimetabolites

- Cell cycle specific - S phase
- Interfere with DNA synthesis
- Dose-limiting toxicities:
  - Bone marrow suppression
  - GI and mucosal toxicity
- Examples: cytarabine, 5-fluorouracil, methotrexate

(Olsen et al., 2023; Vlcek, 2022)

Antitumor Antibiotics

- Cell cycle ~~non~~specific
- Binds to DNA preventing RNA synthesis
- Dose limiting toxicities:
  - Myelosuppression
  - GI toxicity
  - Alopecia
  - Organ toxicity – cardiotoxicity, pulmonary toxicity
- Examples: doxorubicin, daunorubicin, bleomycin, mitomycin

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(Olsen et al., 2023 ; Vlcek, 2022)

Miscellaneous Agents

- Unique actions and side effect profiles
- Examples: asparaginase, arsenic

(Olsen et al., 2023)

Nitrosoureas

- Cell cycle nonspecific
- Causes breakage in DNA strand, preventing replication
- Crosses the blood-brain barrier
- Dose limiting toxicities:
  - Bone marrow suppression
  - GI toxicities
  - Organ damage – renal, hepatic
- Examples: carmustine, lomustine, streptozocin

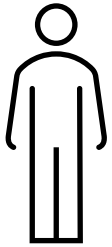
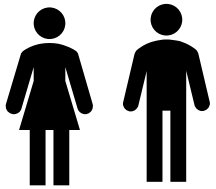
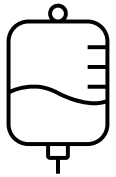
(Olsen et al., 2023 ; Vlcek, 2022)

Plant Alkaloids

- Cell cycle specific
- Types:
  - Camptothecins – irinotecan, topotecan
  - Epipodophyllotoxins – etoposide
  - Taxanes – paclitaxel, docetaxel
  - Vinca alkaloids – vincristine, vinblastine
- Toxicities:
  - Myelosuppression
  - Peripheral neuropathy

(Olsen et al., 2023 ; Vlcek, 2022)

Drug Administration

 Do your homework	 Know your patient	 Verify the order
 Prepare the drug	 Safe Handling	 Dose verification
 Administer the drug	 Monitor the patient	 Document

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(Olsen et al., 2023; Neuss et al, 2016)

Immediate Complications

Vesicant Extravasation

- Drugs at risk
- Prevention
- Treatment

Infusion Reaction

- Hypersensitivity
- Cytokine Release Syndrome
- Anaphylaxis

(Olsen et al., 2023)

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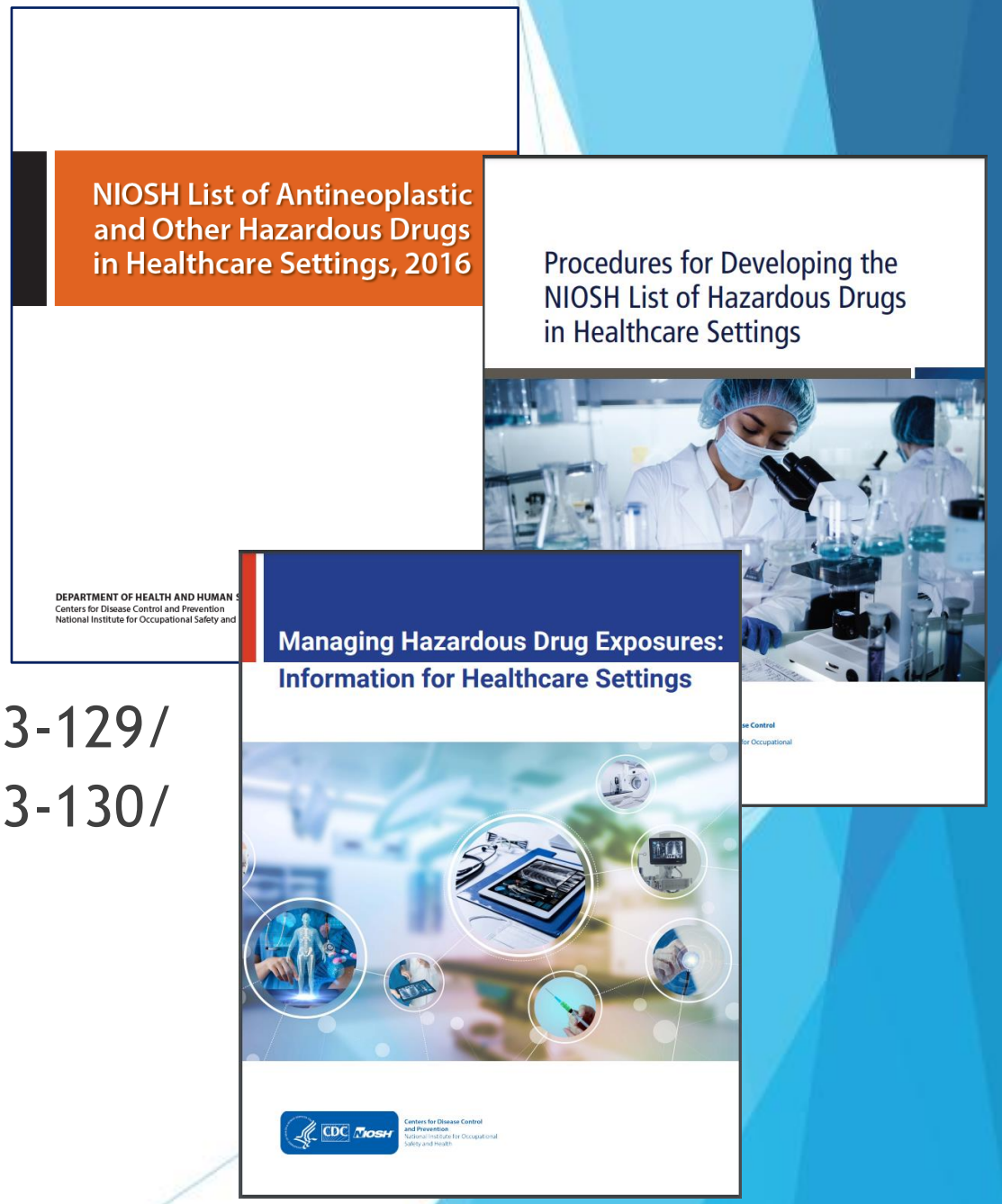
Hazardous Drug Safety

- Identifying hazardous drugs
- Compounding HDs
- Personal Protective Equipment
- Spill management

- NIOSH List –
  - https://www.cdc.gov/niosh/docs/2023-129/
  - https://www.cdc.gov/niosh/docs/2023-130/
- USP Chapter <800>
- Safe Handling Learning Library



(Polovich & Olsen, 2018)

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Hormone Therapy

- Cell cycle nonspecific
- Cancer cell growth in hormone-sensitive cancers may be inhibited by suppression of select hormones
- Side effects may include headache, hot flashes, mood and appetite changes
- Classes include androgens, antiandrogens, aromatase inhibitors, progestins

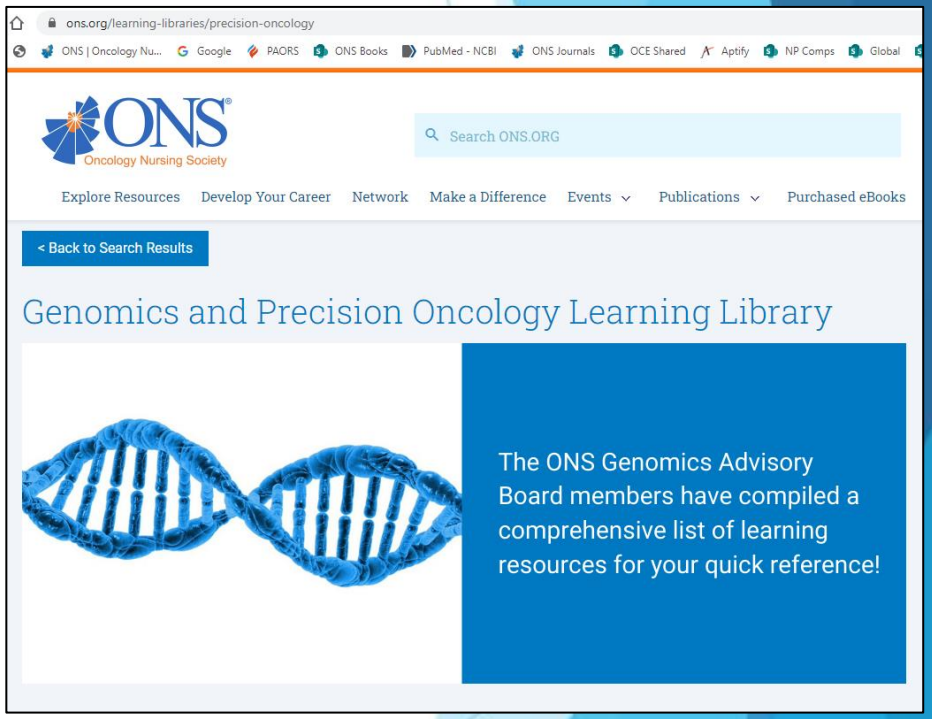
(Davis & Howard, 2020; Olsen et al., 2023)

Photo by Anastasiia Ostapovych on Unsplash

Targeted Therapy

Genomics in Cancer Care

- Course > Genomic Foundations for Precision Oncology
- Taxonomy
- “Glad You Asked” video series
- Learning Activities
- Clinical Practice Resources
- Biomarker Database



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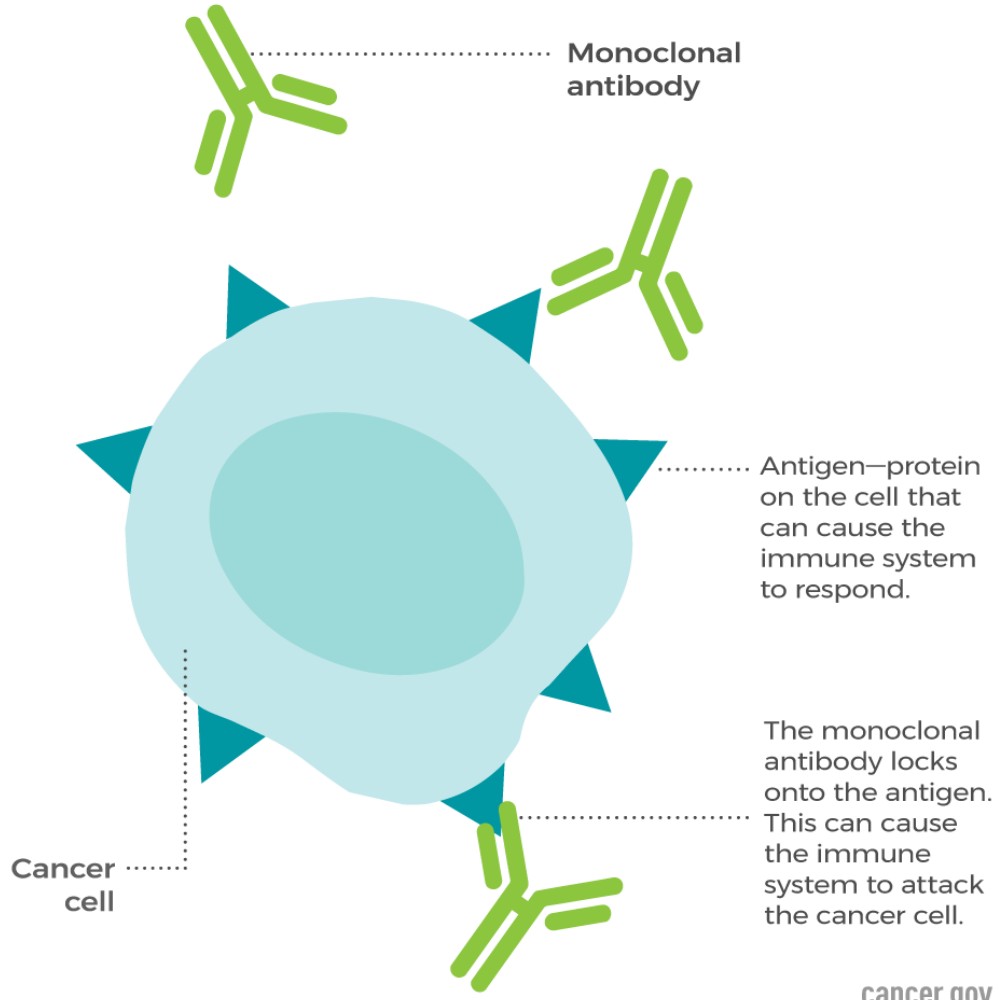
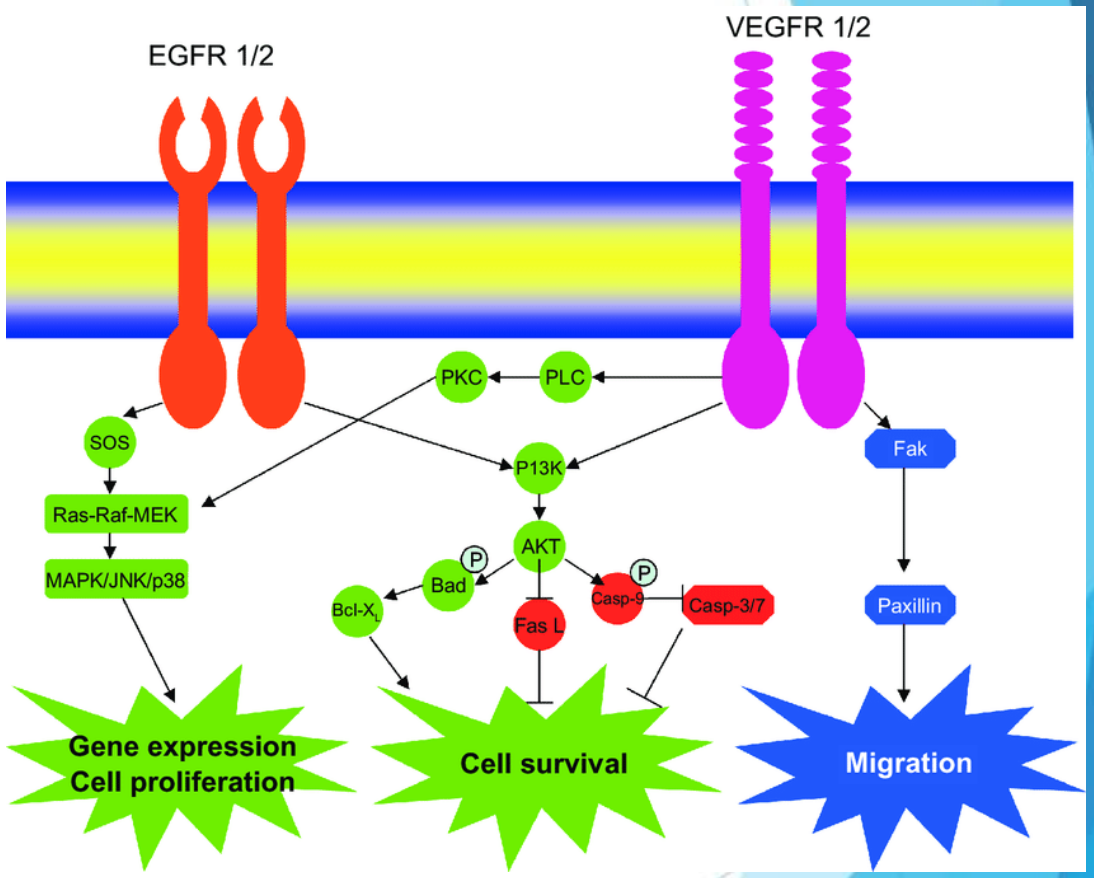
https://www.ons.org/learning-libraries/precision-oncology

Targeted Therapies



Targeted Therapies

- Oral antineoplastics
  - Small molecule inhibitors
    - TKI's
    - RTKs
    - mTOR
    - Proteasome inhibitors
    - PARP Inhibitors
    - CDK4/6



(Olsen et al., 2023; Image from Breast Cancer (Auckl). 2009; 3: 47-6 Published online 2009 Aug 17. doi: 10.4137/bcbcr.s2492 This is an open access article distributed under the terms of the Creative Commons Attribution License (http://www.creativecommons.org/licenses/by/2.0) which permits unrestricted use, distribution and reproduction provided the original work is properly cited.)

Side effects

- EGFRI Skin reactions
- Cardiac toxicities
- Fluid retention
- Mucositis
- Diarrhea

Oral Antineoplastics

- Patient and family education
- Drug adherence
- Ongoing monitoring

- Oral Chemotherapy Education Sheets
- Oral Anticancer Medication Toolkit

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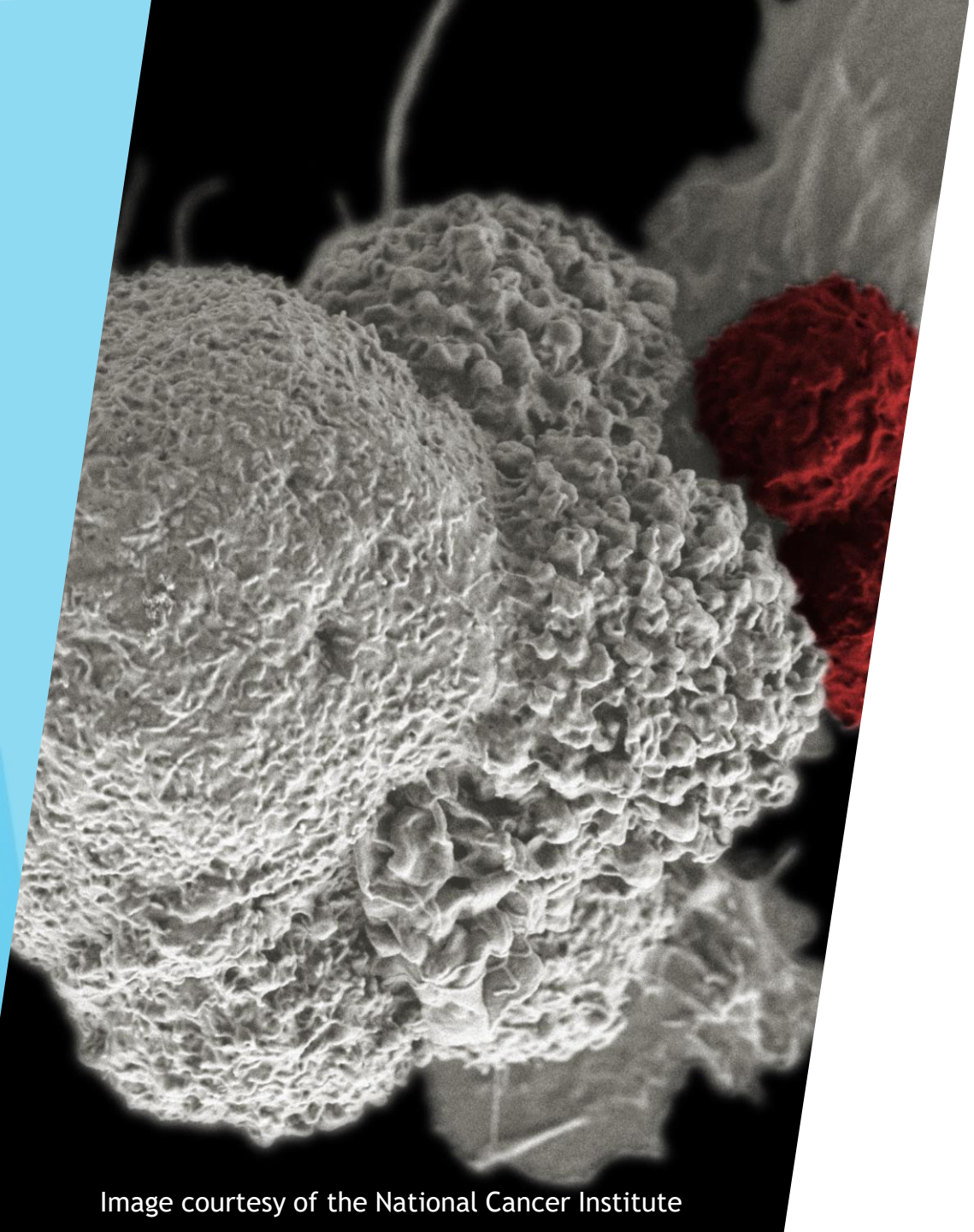


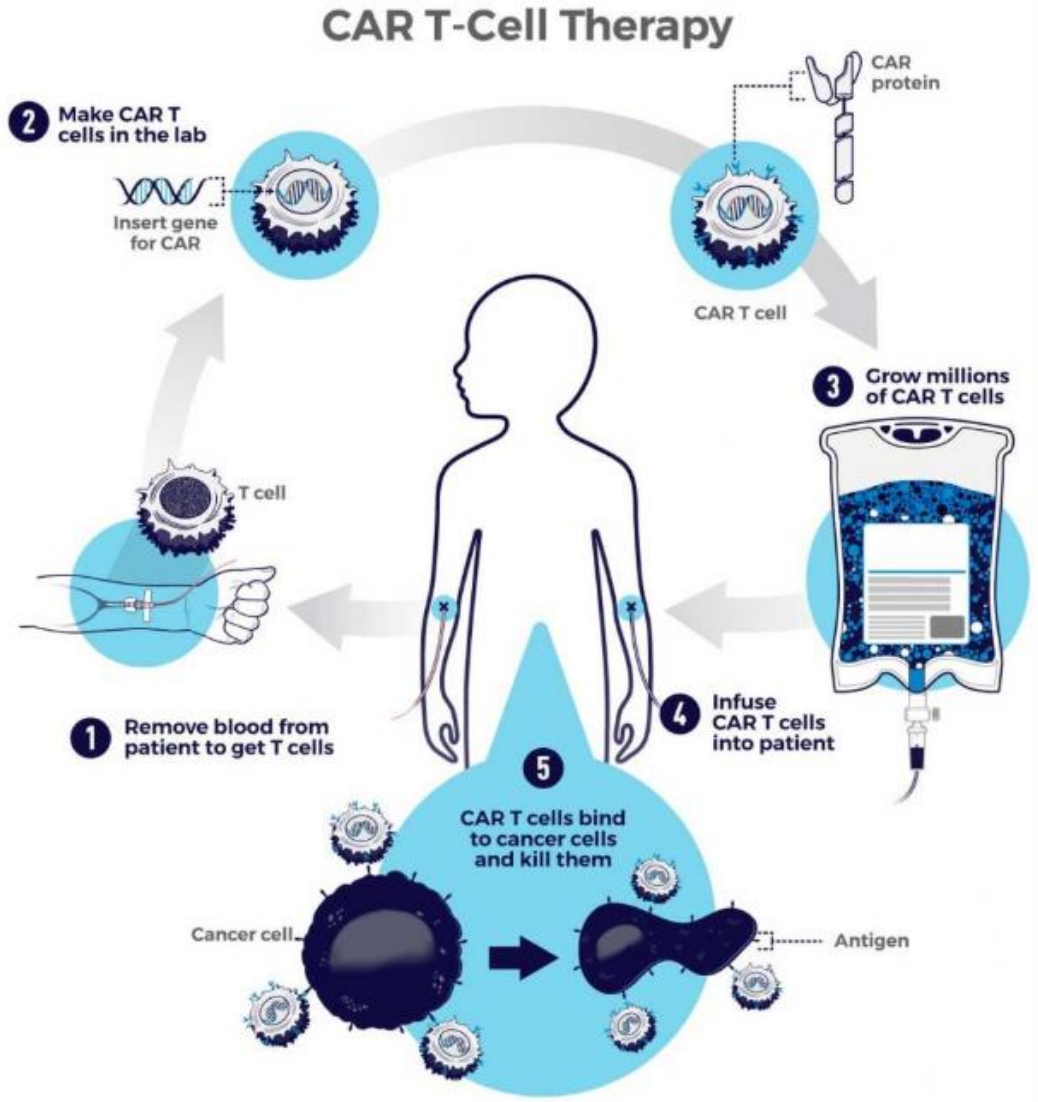
Image courtesy of the National Cancer Institute

Immunotherapy

Cytokines

- Small protein molecules that are activated by stimulus
- Affect the growth and development of cells
- May enhance cytotoxic activity
- Examples include filgrastim, erythropoietin, interleukin, interferon

(Olsen et al., 2023)



Chimeric Antigen Receptor (CAR) T-Cell Immunotherapy

(Olsen et al., 2023; Image courtesy of the National Cancer Institute)

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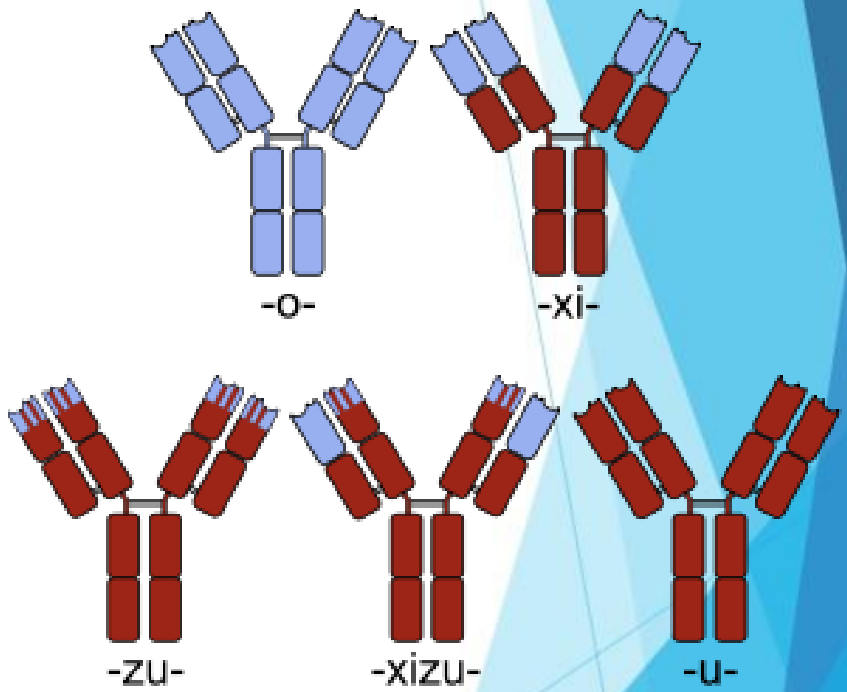
Monoclonal Antibodies

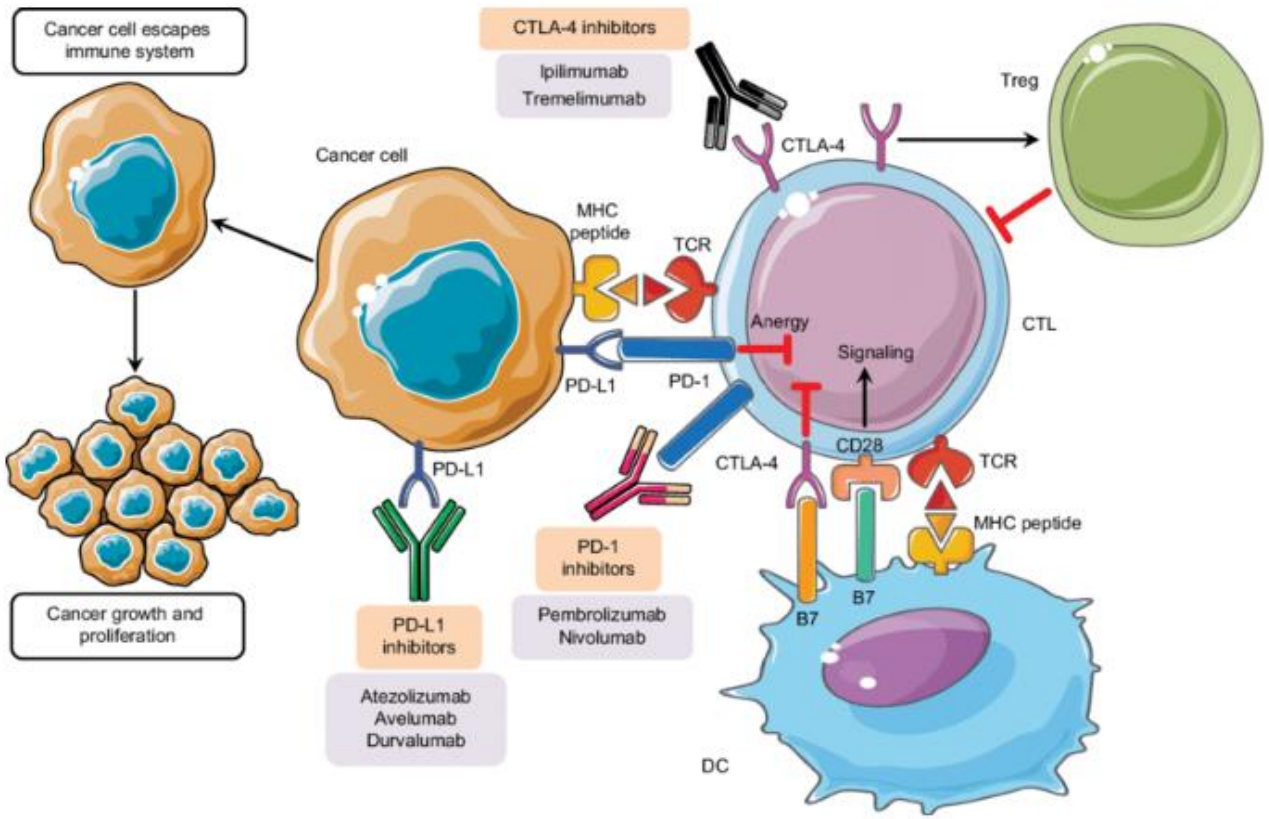
- Manmade antibodies sensitized to a specific antigen present on a tumor cell
- May be derived from human (daratumumab), murine (ibritumomab tiuxetan), chimeric (rituximab), or humanized (trastuzumab) antibodies
- Side effects include flu-like symptoms, skin reactions, rash, hypersensitivity reactions



Olsen et al., 2023; Image available in public domain at https://upload.wikimedia.org/wikipedia/commons/4/44/Chimeric_and_humanized_antibodies.svg

Checkpoint Inhibitors

- Block proteins that stop recognition of cancer cells by the immune system
- Side effects include immune-related adverse events
- Examples include pembrolizumab, nivolumab

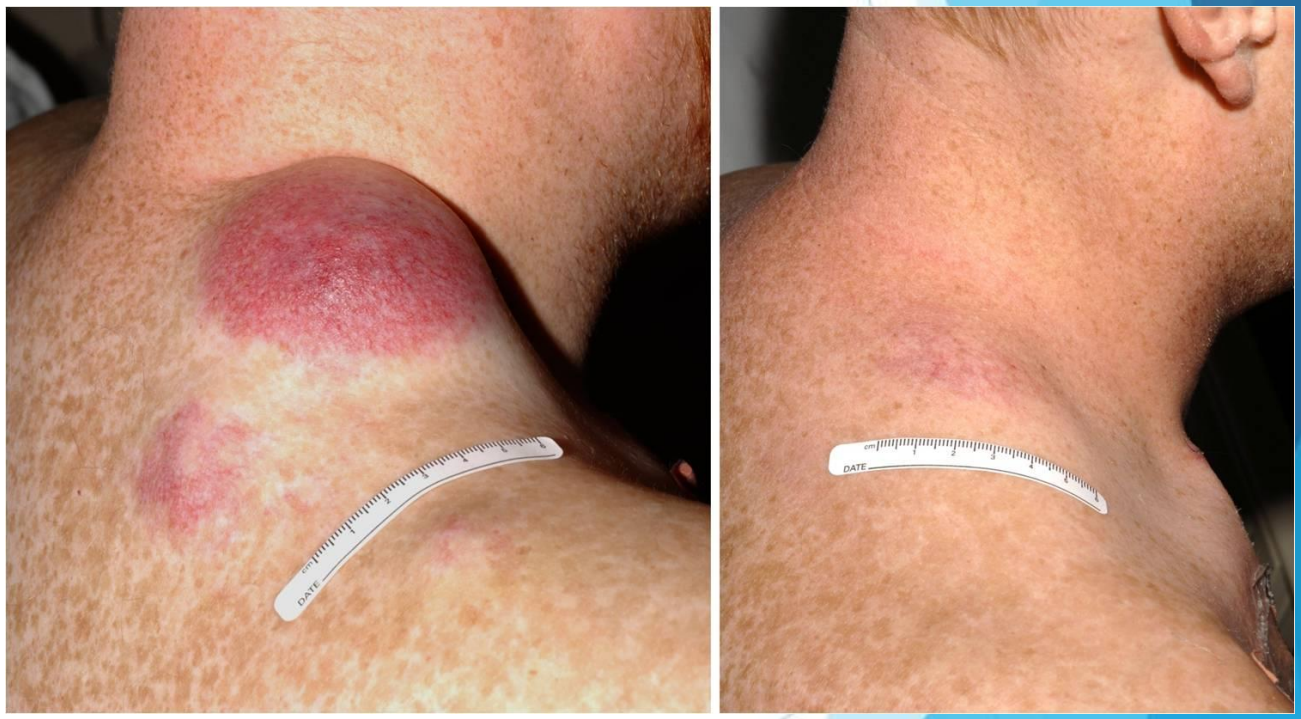


(Olsen et al., 2023; Figure via license: CC BY-NC 3.0 from https://www.researchgate.net/figure/mmune-checkpoint-inhibitors-in-cancer-treatment-Notes-inability-to-activate-CTLs-in_fig1_330435495)

Adoptive Cellular Therapy

Tumor-infiltrating lymphocytes

- T cells are extracted from inside the tumor
- Cells are treated and reproduced in large numbers
- T cells are infused back into the patient and they attack the tumor cells



(Olsen et al., 2023; Image courtesy of the National Cancer Institute)

Active Immunotherapy: Oncolytic Viruses

- Oncolytic viruses are injected into a tumor
- The virus replicates inside tumor cells
- The tumor cell ruptures and contents are spilled into the surrounding environment
- Other tumor cells pick up the virus and the cycle continues
- Infection control procedures must be in place
- Download the Safe Handling of Oncolytic Viruses resource from www.ons.org

(Olsen et al., 2023)

Immune-Related Adverse Events

- Infusion reactions
- Skin rash
- Hepatic toxicity
- Fatigue
- Pneumonitis
- GI toxicity

Immuno-Oncology Learning Library

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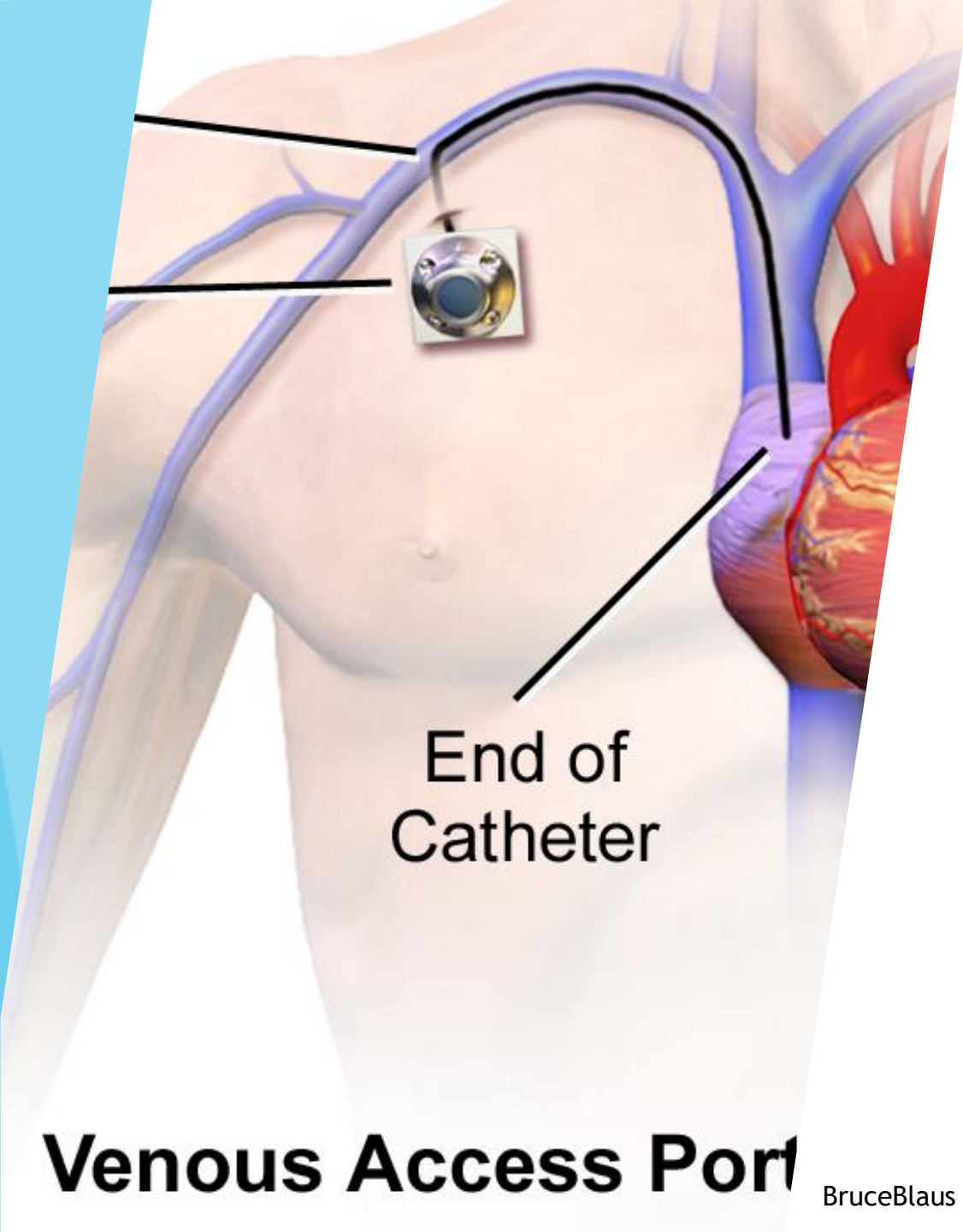
(Olsen et al., 2023)



Access Devices

Access Devices: Purpose

- Combination therapy
- Administer therapy into multiple body systems
- Supportive therapy
- Laboratory monitoring

(Camp-Sorrell, 2020)

Access Devices: Types

- Venous
  - Peripheral
  - Midline
  - Short-term central
  - Long-term central
    - Tunneled
    - Implanted port
    - PICC

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(Camp-Sorrell, 2020; Camp-Sorrell & Matey, 2017)

Access Devices: Types

- Arterial
- Peritoneal
- Intraventricular
- Epidural
- Intrapleural

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(Camp-Sorrell, 2020)

Access Devices: Complications

- Infection
- Occlusion
- Catheter Tip migration
- Air embolism
- Pneumothorax
- Arterial injury
- Phlebitis
- Extravasation
- Arrythmia

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(Camp-Sorrell, 2020)

Access Devices: Assessment

- Identify potential candidates
- Physical exam
- Psychosocial exam

(Camp-Sorrell, 2020)

References

Each citation noted refers to a chapter in one of the following texts:

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