ACADEMY of ONCOLOGIC PHYSICAL THERAPY

Knowledge | Compassion | Practice | Results

What to Know about Oncology Rehabilitation for the Outpatient Clinician

Frannie Westlake PT, DPT

Board Certified Oncology Clinical Specialist

Board Certified Neurologic Clinical Specialist

ACADEMY of ONCOLOGIC PHYSICAL THERAPY

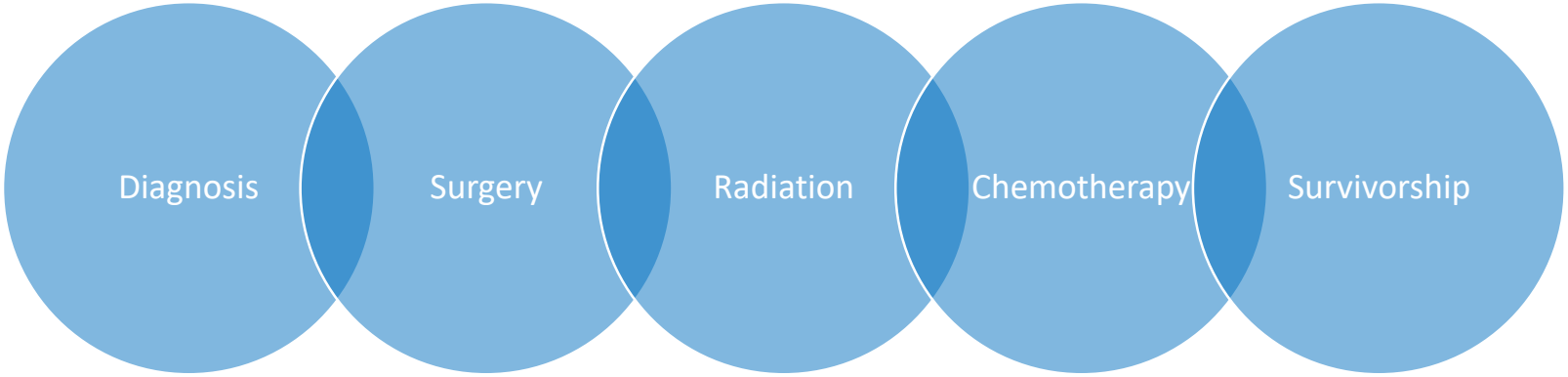
Knowledge | Compassion | Practice | Results

Course Objectives

- Review pathophysiology of cancer, prevalence and important statistics.
- Explain techniques used to diagnose, surgically and medically treat cancer.
- Review appropriate exercise prescriptions when treating patients who have a past or current diagnosis of cancer.
- Learn precautions, contraindications and red flags to look for when working with cancer survivors.
- Review of oncologic emergencies, lab values and screening used to determine safety when treating a patient with a history of cancer.

Rehabilitation in Cancer Care

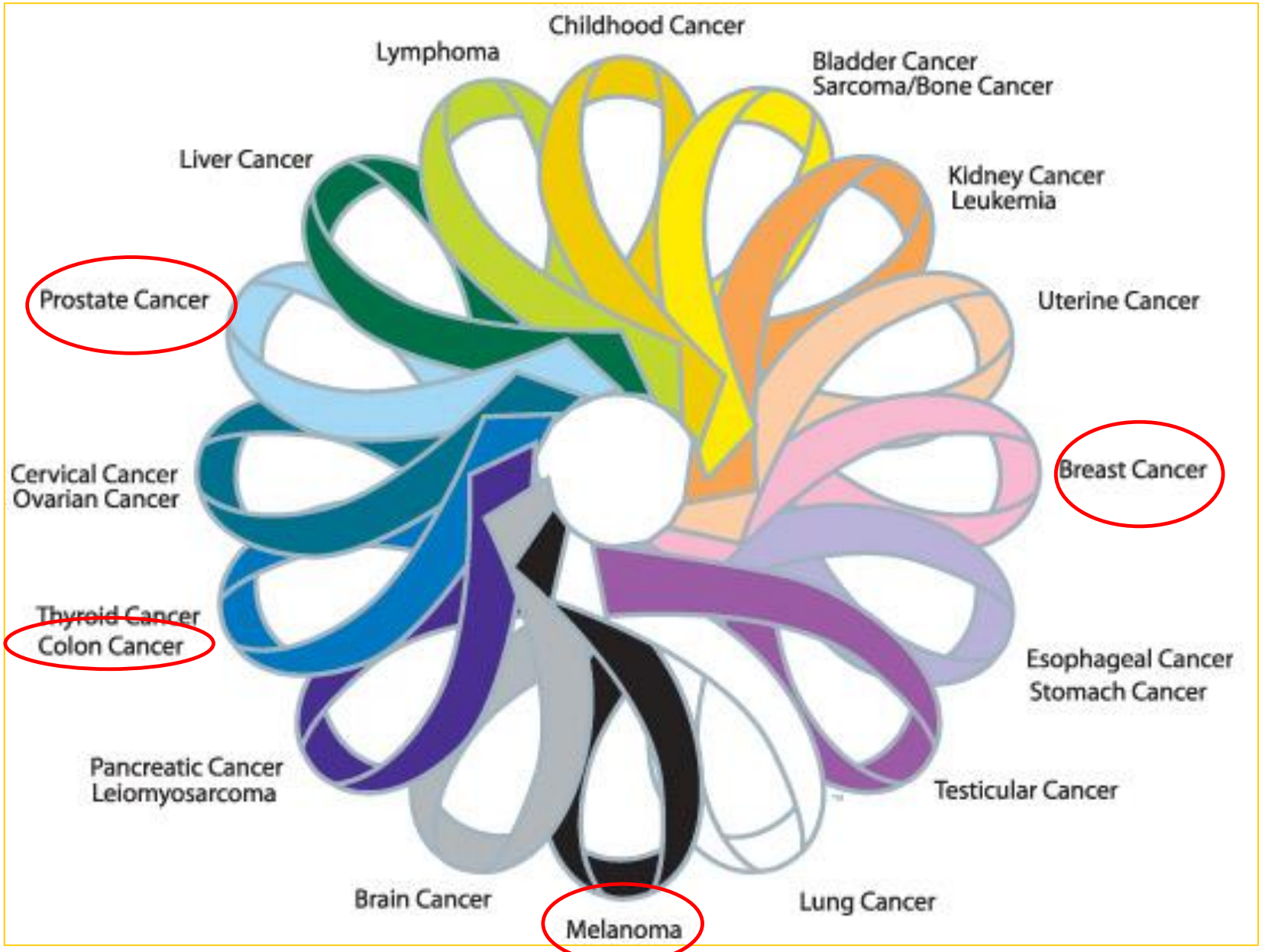
- Cancer Rehabilitation is defined as:
  - “any functional or rehabilitation intervention for any cancer patient at any point along the cancer continuum with a goal of increasing personal ability. “ – Gail Gamble MD at RIC



© PORI

https://cancerstatisticscenter.cancer.org/#!/

© PORi


Childhood Cancer
Lymphoma
Bladder Cancer
Sarcoma/Bone Cancer
Liver Cancer
Kidney Cancer
Leukemia
Prostate Cancer
Uterine Cancer
Cervical Cancer
Ovarian Cancer
Breast Cancer
Thyroid Cancer
Colon Cancer
Esophageal Cancer
Stomach Cancer
Pancreatic Cancer
Leiomyosarcoma
Testicular Cancer
Brain Cancer
Lung Cancer
Melanoma

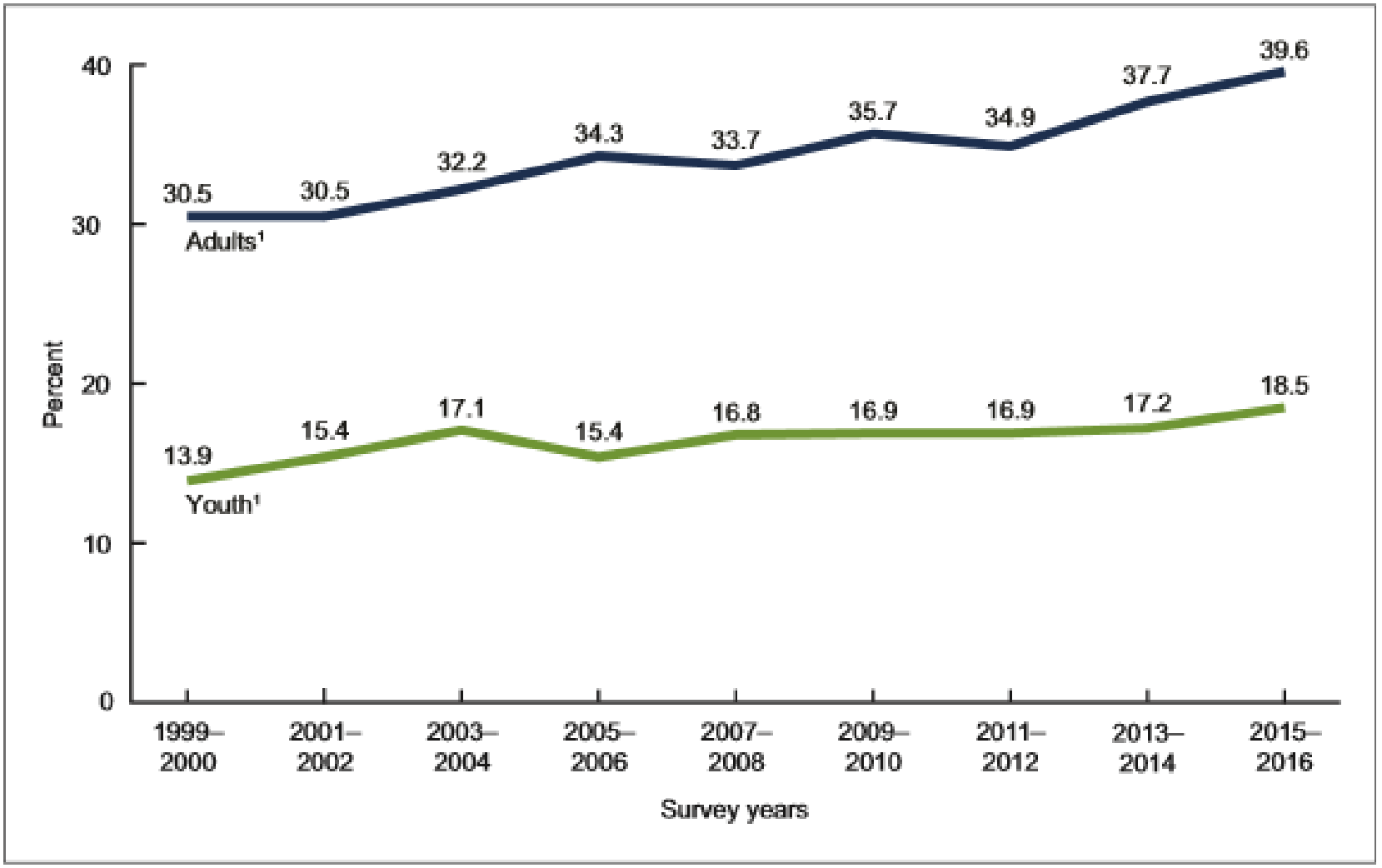
What is Cancer?

- Group of diseases characterized by uncontrolled growth and spread of abnormal cells.
- **Causes**
  - External factors: tobacco, infectious organisms & unhealthy diet
  - Internal factors: inherited genetic mutations, hormones and immune conditions
- ≥10 years often pass between exposure of external factors and detectable cancer

Cancer Prevention

- Smoking
- Diet
- Activity/exercise
- Obesity

Figure 5. Trends in obesity prevalence among adults aged 20 and over (age adjusted) and youth aged 2–19 years: United States, 1999–2000 through 2015–2016



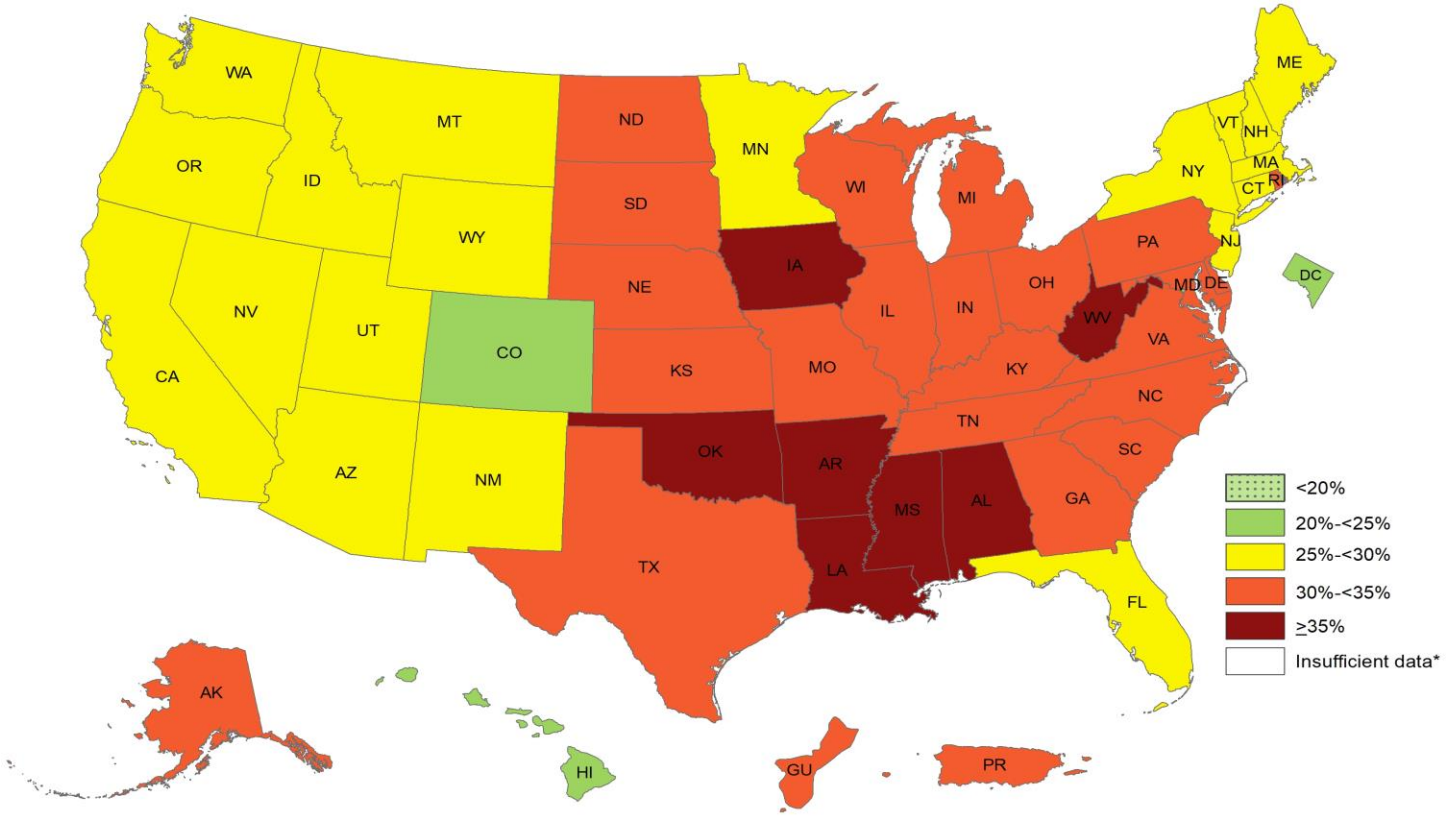
[1]Significant increasing linear trend from 1999–2000 through 2015–2016.

NOTES: All estimates for adults are age adjusted by the direct method to the 2000 U.S. census population using the age groups 20–39, 40–59, and 60 and over. Access data table for Figure 5 at: https://www.cdc.gov/nchs/data/databriefs/db288_table.pdf#5.

SOURCE: NCHS, National Health and Nutrition Examination Survey, 1999–2016.

Prevalence¶ of Self-Reported Obesity Among U.S. Adults by State and Territory, BRFSS, 2017

¶ Prevalence estimates reflect BRFSS methodological changes started in 2011. These estimates should not be compared to prevalence estimates before 2011.



***Sample size <50 or the relative standard error (dividing the standard error by the prevalence) ≥ 30%.**

Who gets cancer?

- Most commonly develops in older people
- 78% of all cancers ≥55 years
- In US, lifetime risk of developing cancer:
  - Men (slightly less than 1 in 2)
  - Women (slightly more than 1 in 3)

SEER Stat Fact Sheet: Cancer of Any Site

At a Glance

Estimated New Cases in 2019	1,762,450
% of All New Cancer Cases	100.0%

Estimated Deaths in 2019	606,880
% of All Cancer Deaths	100.0%

Percent Surviving 5 Years
67.1%
2009-2015

https://seer.cancer.gov/statfacts/html/all.html

How Many People Survive 5 Years Or More after Being Diagnosed with Cancer of Any Site?

Percent Surviving 5 Years

67.1%

Based on data from SEER 18 2009-2015. Gray figures represent those who have died from cancer of any site. Green figures represent those who have survived 5 years or more.

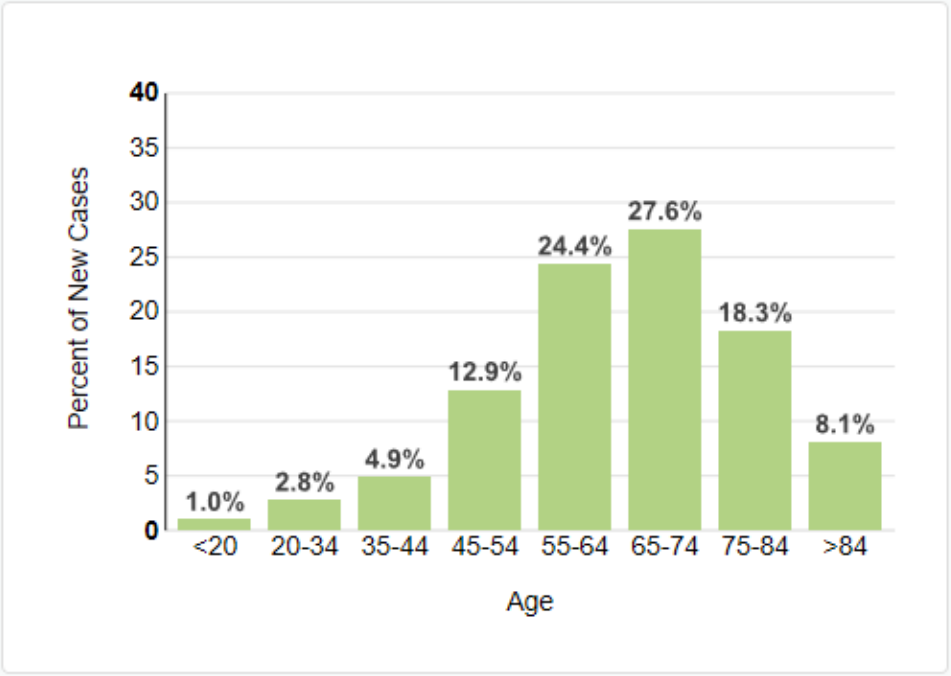
https://seer.cancer.gov/statfacts/html/all.html

Number of new Cases & Deaths

	Common Types of Cancer	Estimated New Cases 2019	Estimated Deaths 2019
1.	Breast Cancer (Female)	268,600	41,760
2.	Lung and Bronchus Cancer	228,150	142,670
3.	Prostate Cancer	174,650	31,620
4.	Colorectal Cancer	145,600	51,020
5.	Melanoma of the Skin	96,480	7,230
6.	Bladder Cancer	80,470	17,670
7.	Non-Hodgkin Lymphoma	74,200	19,970
8.	Kidney and Renal Pelvis Cancer	73,820	14,770
9.	Uterine Cancer	61,880	12,160
10.	Leukemia	61,780	22,840
	-	-	-
	Cancer of Any Site	**1,762,450**	**606,880**

Percent of New Cases by Age Group

Percent of New Cases by Age Group: Cancer of Any Site



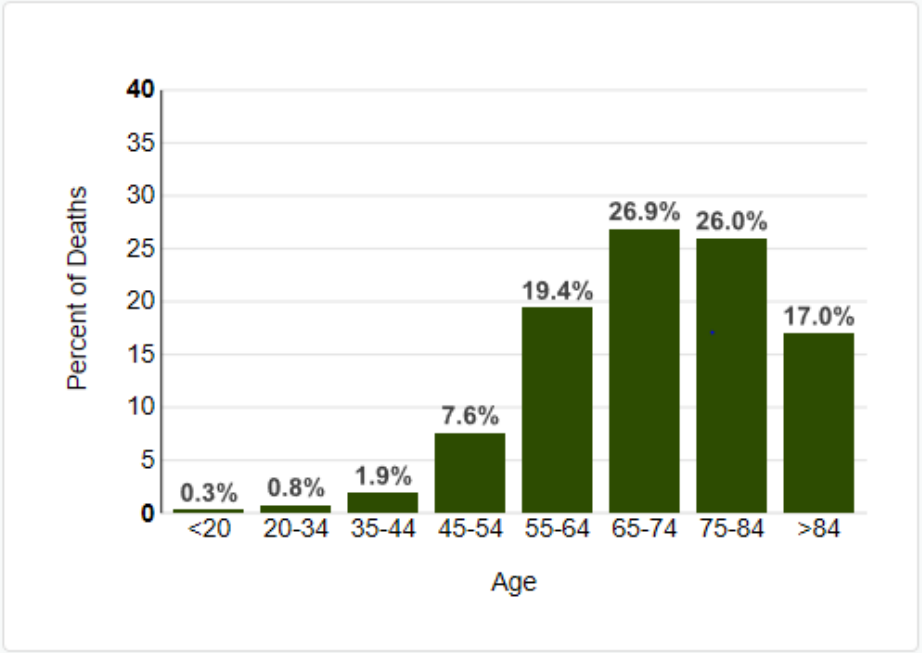
Cancer of any site is most frequently diagnosed among people aged 65-74.

Median Age At Diagnosis
66

SEER 21 2012-2016, All Races, Both Sexes

% of Deaths by Age Group

Percent of Deaths by Age Group: Cancer of Any Site



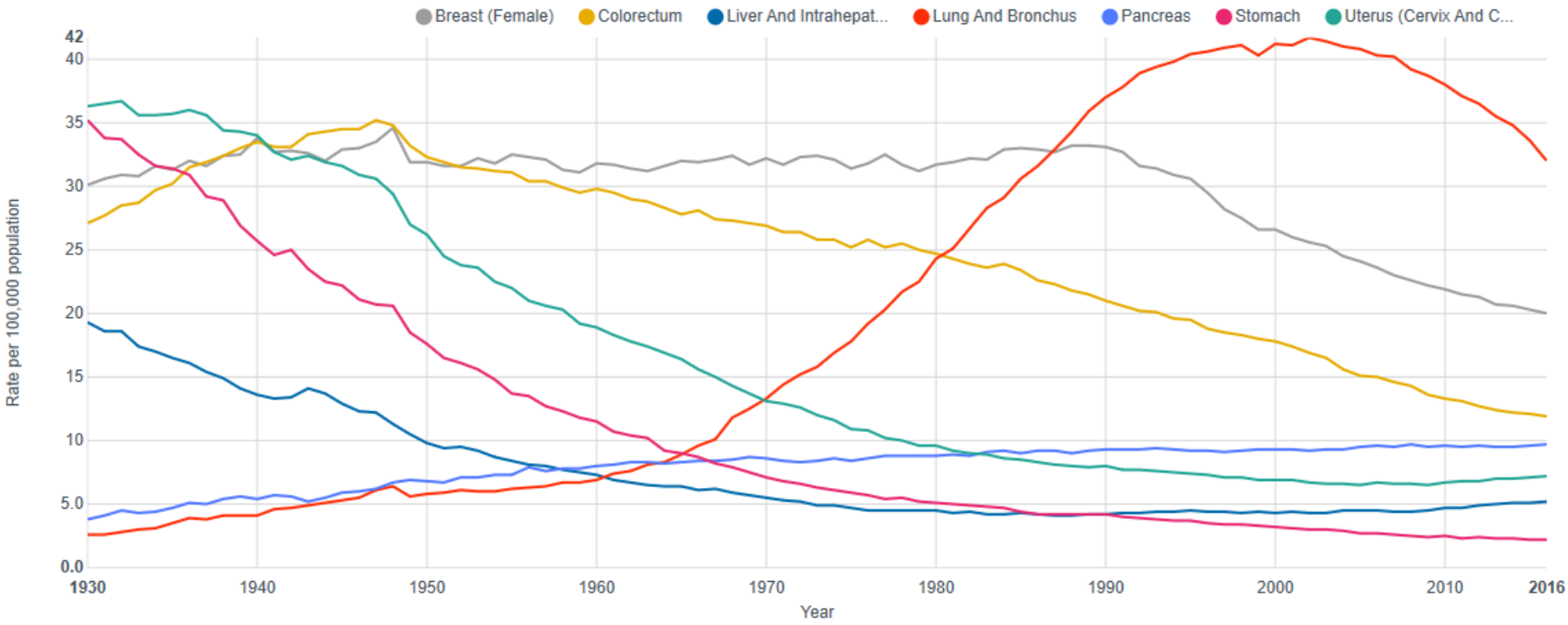
The percent of cancer of any site deaths is highest among people aged 65-74.

Median Age At Death
72

U.S. 2012-2016, All Races, Both Sexes

Trends in death rates, 1930-2016

Females

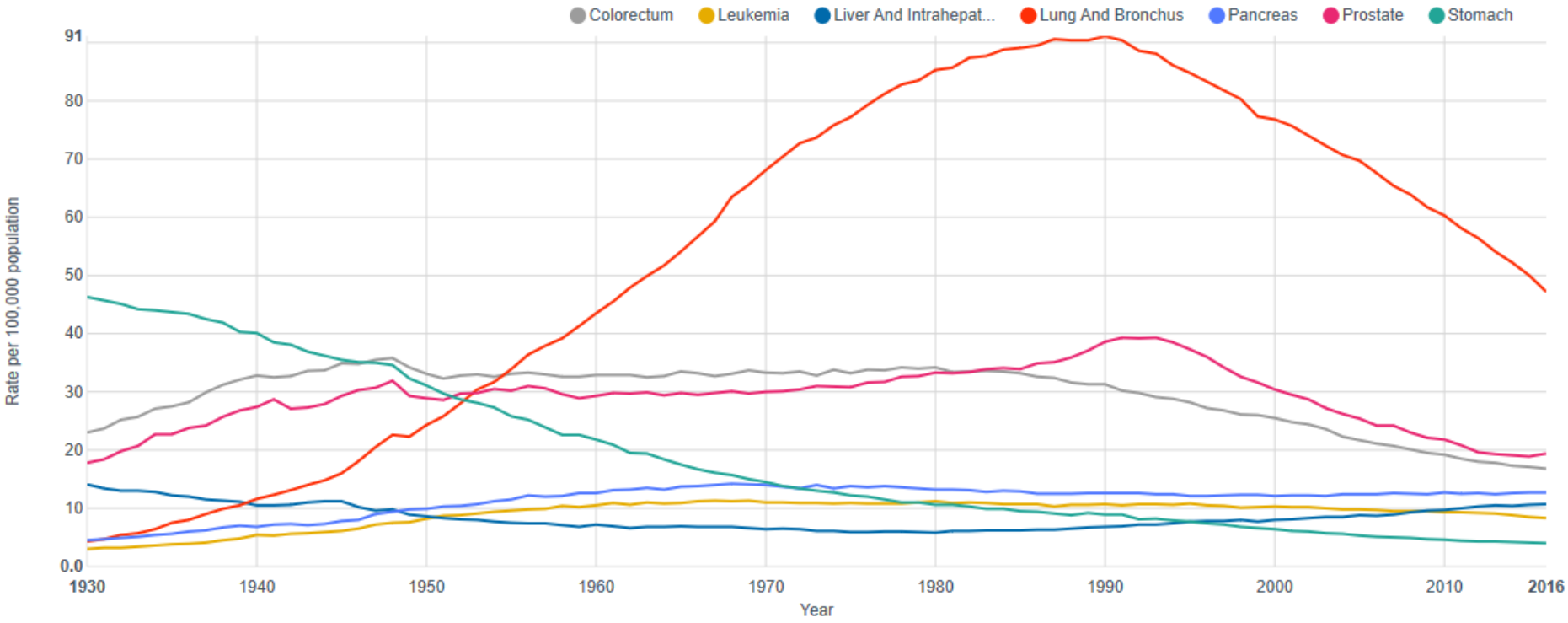


Per 100,000, age adjusted to the 2000 US standard population.

Data sources: National Center for Health Statistics (NCHS), Centers for Disease Control and Prevention, 2017

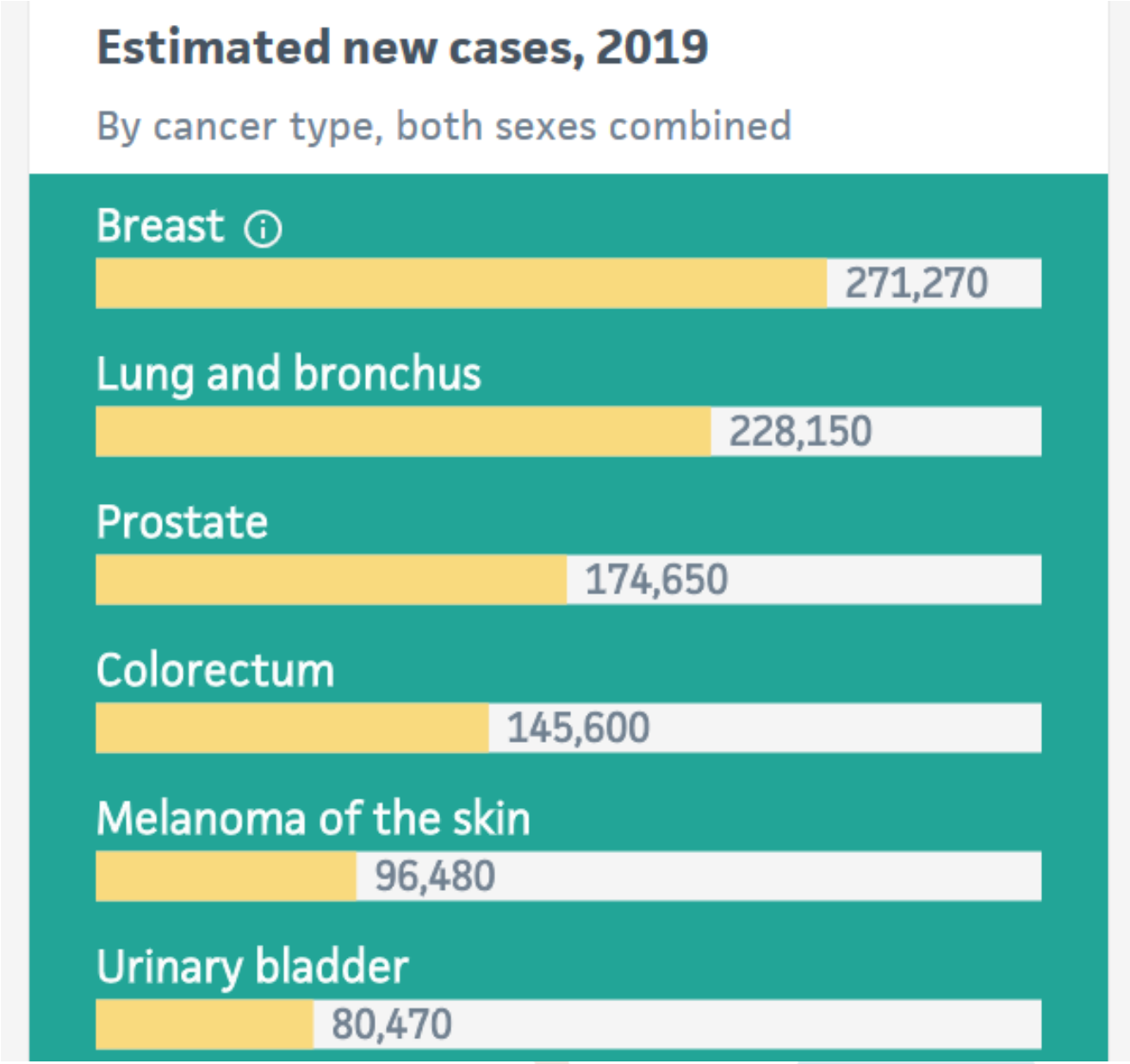
Trends in death rates, 1930-2016

Males



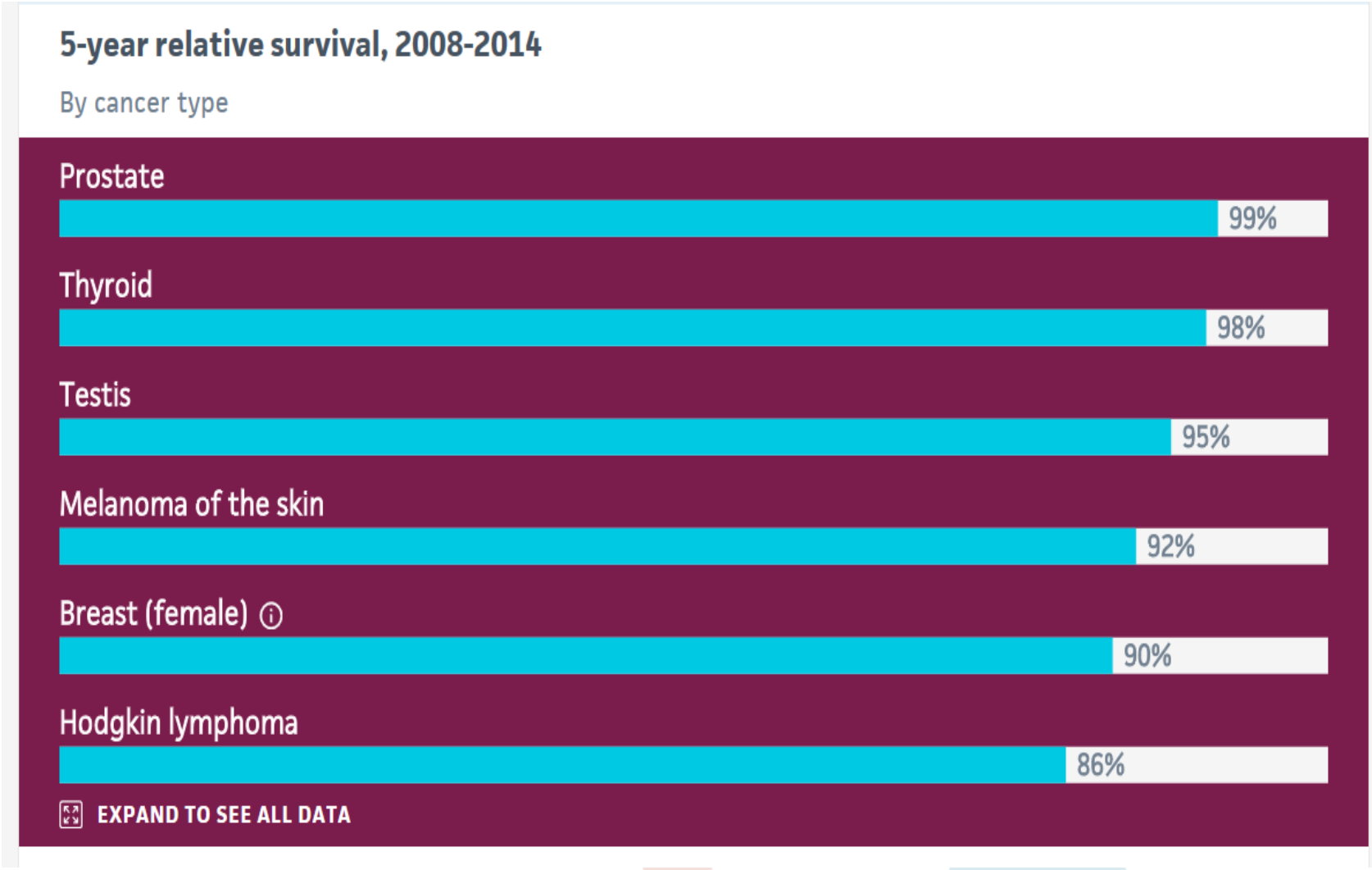
Per 100,000, age adjusted to the 2000 US standard population.

Data sources: National Center for Health Statistics (NCHS), Centers for Disease Control and Prevention, 2017



https://cancerstatisticscenter.cancer.org/#!/

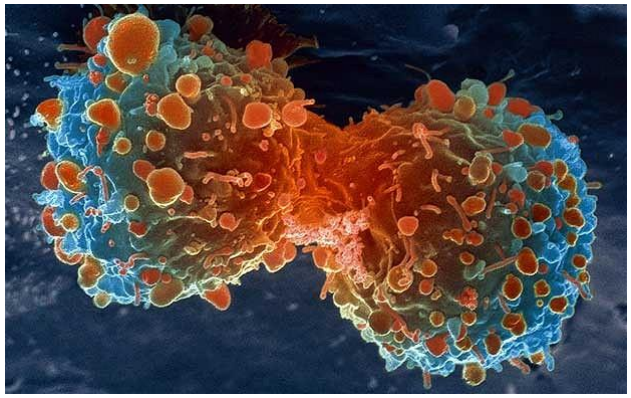
© PORi



https://cancerstatisticscenter.cancer.org/#!/

© PORi

What is Cancer?



ACADEMY of ONCOLOGIC PHYSICAL THERAPY

Knowledge | Compassion | Practice | Results

Terminology

- Tumor (neoplasm): an abnormal growth of new tissue that is non-functional and competes for vital blood supply and nutrients.
  - **Benign:**
    - Localized
    - Slow growing
    - Encapsulated
    - Not invasive
  - **Malignant:**
    - Invasive
    - Rapid growing
    - Usually encapsulated in early stages

Cancer Terminology

- **Carcinomas**
  - Arise from epithelial tissues
    - Breast, colon, pancreas, skin, intestines, lung
  - Metastasize via invasion and infiltration of tissues
- **Sarcomas**
  - Develop from connective tissues
    - Muscle, bone, fibrous
  - Metastasize hematogenously
- **Lymphoma/Leukemia**
  - Originate in cells of the lymphoid tissue
  - Metastasize by lymphatic invasion and infiltration

Biology of Metastasis

- Tumor cells grow at primary site
- Increase in vascularity
- Cells detach into circulatory system
- Growth at secondary site
  - Systemic growth factors enhance growth and spread
  - Characteristics of blood flow in tissues impact growth and spread

Biology of Metastasis

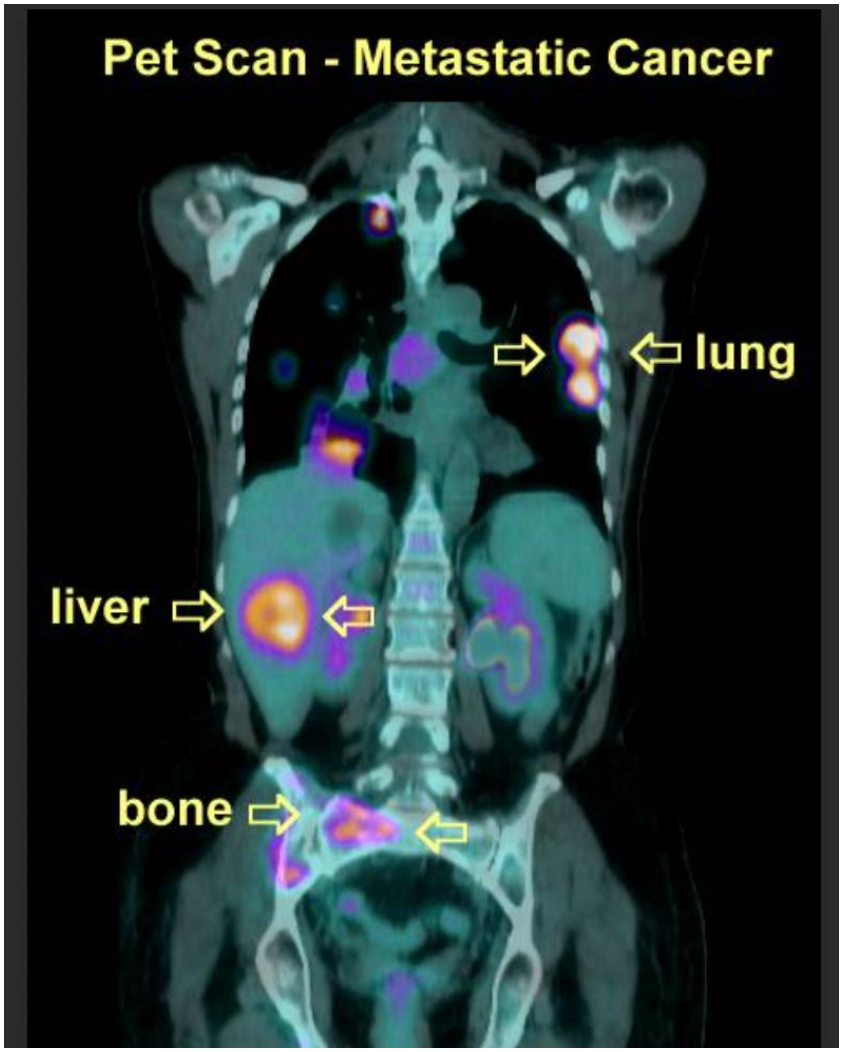
- Metastases have the potential to metastasize
  - Micrometastasis
- For rapidly growing tumors, millions of cells are shed into the circulating blood every day

Diagnosis of Cancer

- Palpable mass or lump
- X-ray
- Mammography
- Magnetic resonance imaging (MRI)
- Computed Tomography (CT)
- Ultrasonography
- Positron Emission Topography (PET)
- Blood work

PET Scan

- Radioactive glucose is injected through IV
- The PET scanner rotates around the body and makes a picture
- Highlights areas where metabolism rates are high
- Malignant tumor cells show up brighter in the picture because they are more active and take up more glucose than normal cells do

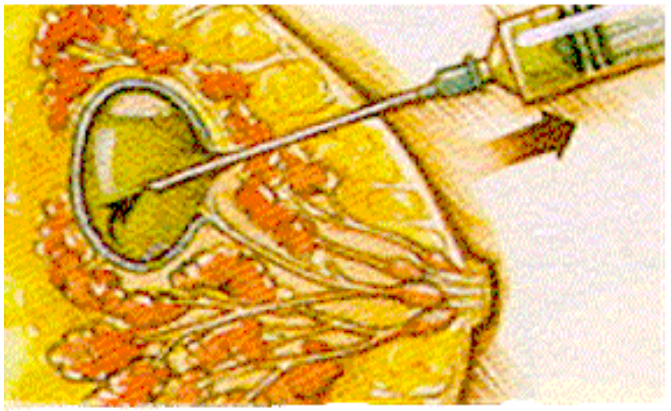

Pet Scan - Metastatic Cancer
lung
liver
bone

Diagnosis of Cancer

- Lumbar puncture - CSF
- Pap smear
- Fiber-optic scope procedures
  - Endoscopy
  - Colonoscopy
- Biopsy- removal of tissue

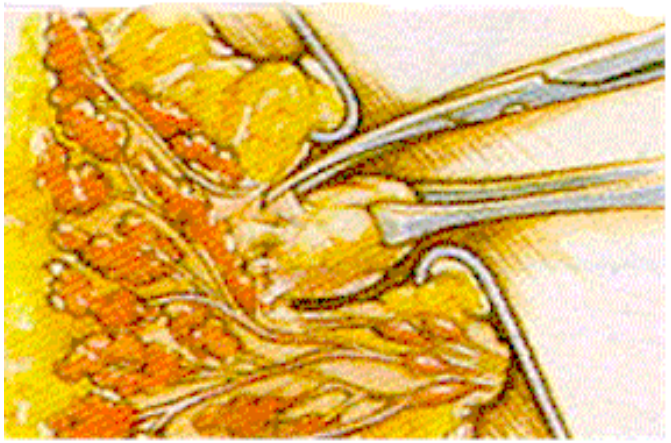
Biopsy Options
Masses and Lumps

- Needle Aspiration
  - Requires palpable mass
  - False negative results are common



Needle Aspiration

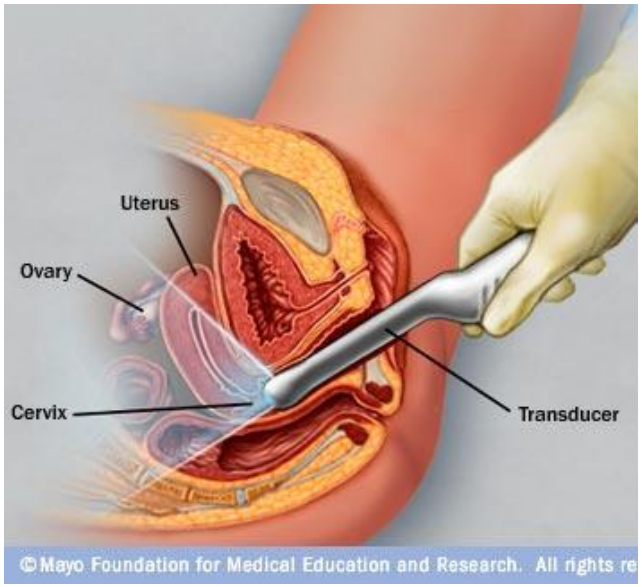
- Surgical Biopsy
  - Excisional biopsy
  - Larger mass of tissue

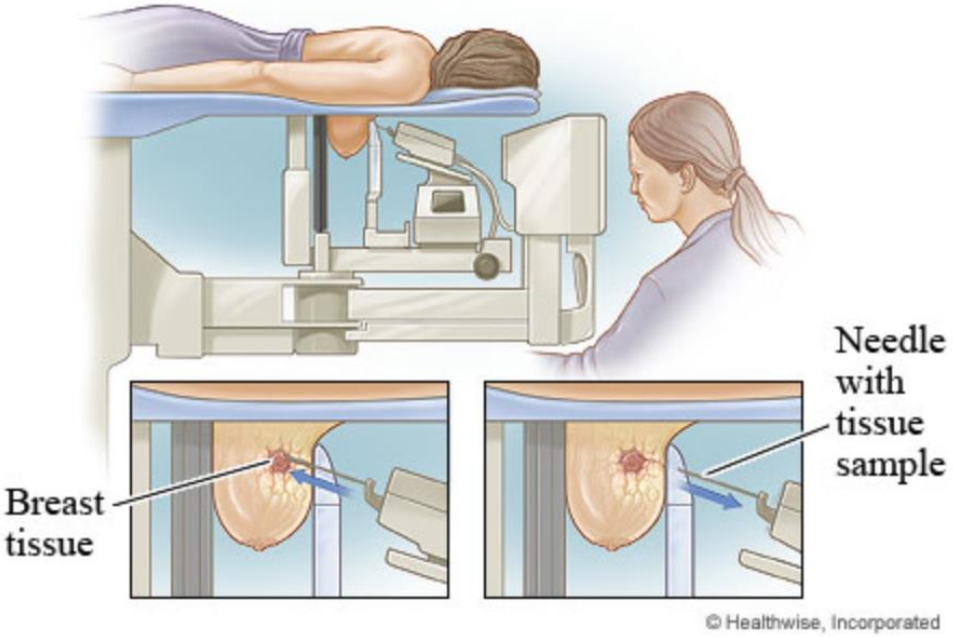


Surgical Biopsy

Biopsy Options Internal Organs

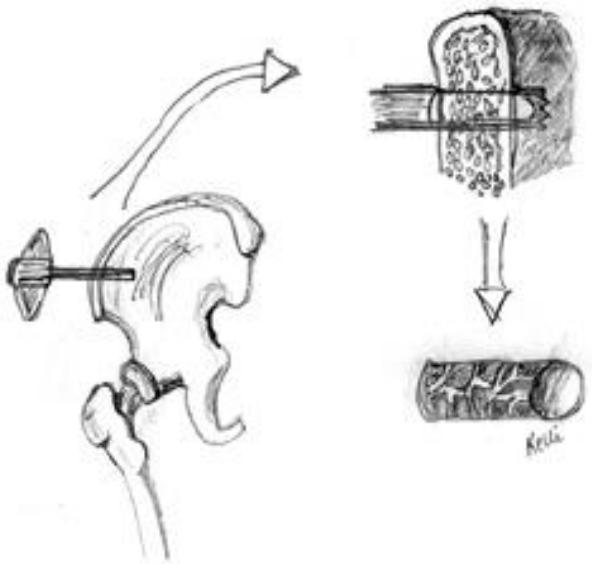
- Ultrasound Guided
- Core biopsies



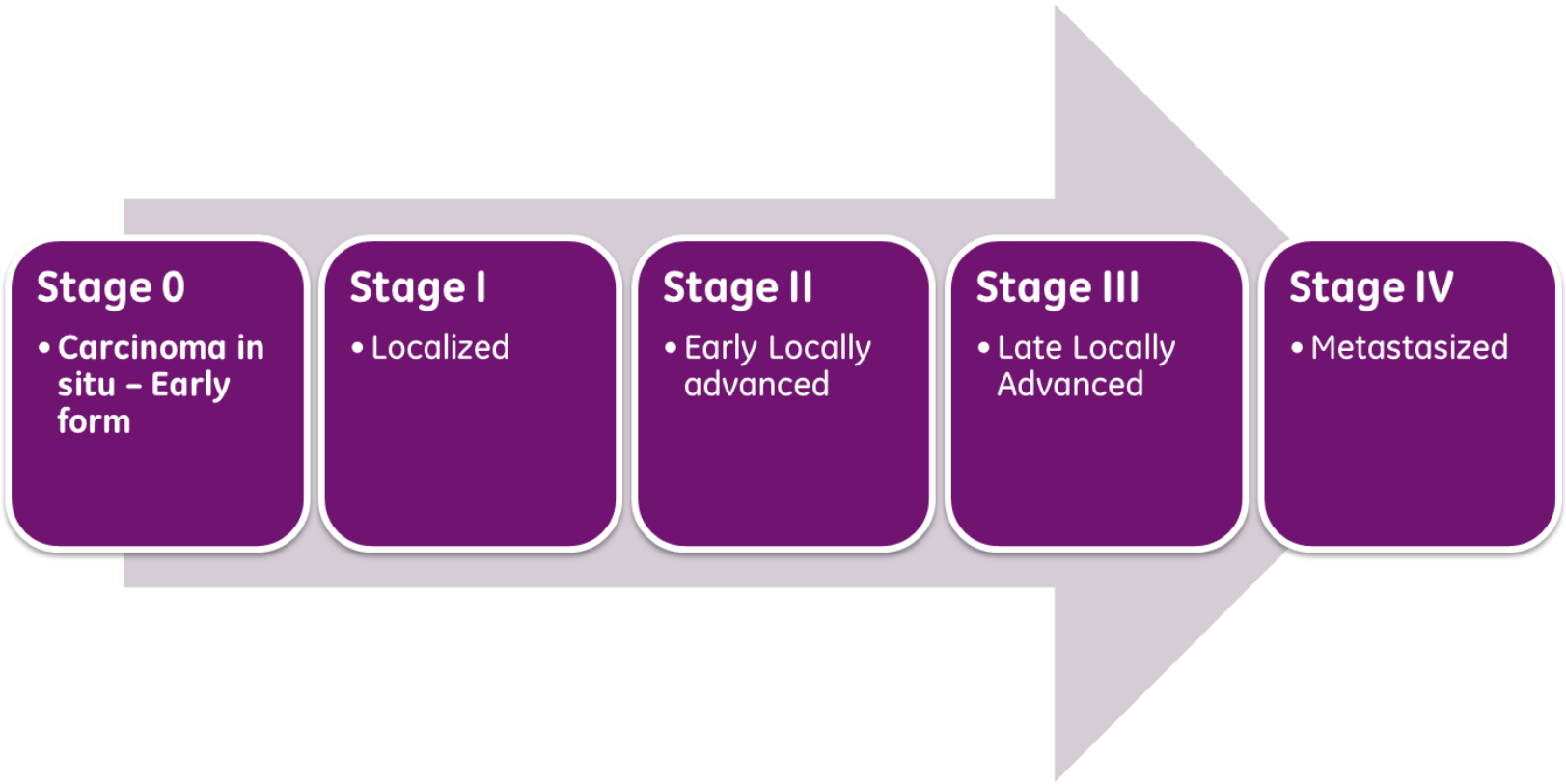


Bone Biopsy

- Core sample taken from known area of disease



How is Cancer Staged?



American Joint Committee on Cancer

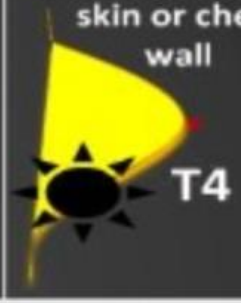
- **Staging**
  - How much cancer there is in the body and where it is located
  - Determines treatment and prognosis
  - Staging provides a common language with which doctors can communicate about a patient's case.

www.cancerstaging.org

Staging of Cancer
TNM Classification

- T: Primary tumor size
- N: Regional lymph node involvement
- M: Metastasis
  - Numbers used to denote extent of involvement, from 1 to 4 (least involvement to most involvement) e.g. T_2 N_1 M_0 T_1 N_0 M_x

TNM Staging

Tumor size **T**	Tumor size < 2 cm 	Tumor size 2-5 cm 	Tumor size > 5 cm 	Tumor extends to skin or chest wall 
Lymph Nodes **N**	**N0** No lymph node metastasis	**N1** Metastasis to ipsilateral, movable, axillary LNs	**N2** Metastasis to ipsilateral fixed axillary, or IM LNs	**N3** Metastasis to infraclavicular/ supraclavicular LN, or to axillary and IM LNs
Metastasis **M**	**M0** No distant metastasis	**M1** Distant metastasis		

Staging of Cancer

- New Primary tumors vs. Recurrence
  - New tumors are
    - Staged
    - Graded
    - Treated appropriate to the disease
  - Recurrent lesions are
    - Identified based on their primary disease
    - Not restaged

Tumor Grading

- Various Grading Scales exist
  - Gleason Scale: Prostate Cancer 2-10

- Higher Grade is associated with a more aggressive cancer

Gleason Scale

Gleason Score	Growth	Percentage
3 + 3 = 6	Slow	44%
3 + 4 = 7	Average	27%
4 + 3 = 7	Moderate Fast	16%
4 + 4 = 8	Faster	10%
9/10	Very Fast	3%

All things considered in treatment planning…

- Stage
- Grade
- Location
- Overall physical status of the patient
- Medical History

Medical Treatment

Cancer Treatment

- Local Treatment
  - Surgery
  - Radiation Therapy
- Systemic Treatment
  - Chemotherapy
  - Hormone therapy
  - Targeted therapy

Medical Interventions:

- Primary Goal? Curative vs. Palliative
- **Combination of Interventions is optimal**
  - Surgery
  - Radiation therapy
  - Chemotherapy
  - Biological therapy
  - Hormone therapy
  - Anti-Angiogensis
- Combined therapy depends on the type of cancer

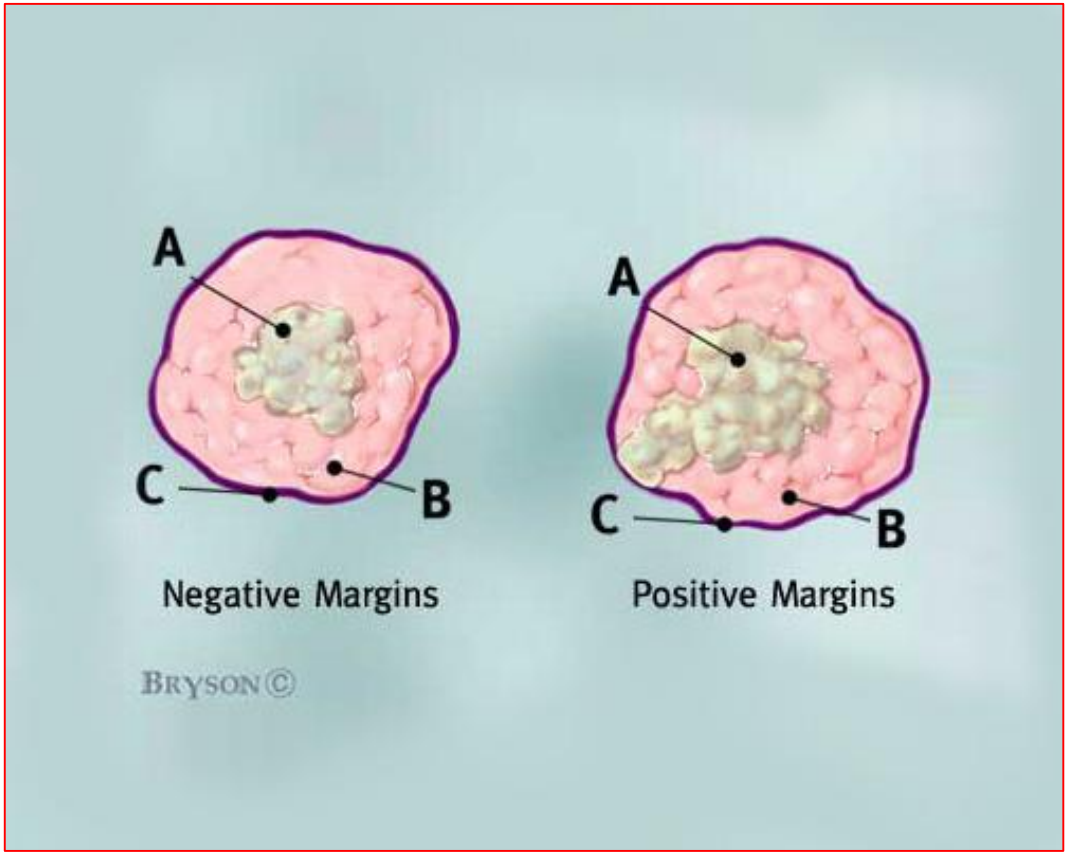
Multi-Disciplinary Team

- Radiologist
- Pathologist
- Surgical Oncologist
- Medical Oncologist
- Radiation Oncologist
- *Physical and Occupational Therapist*
- *Speech/Language Pathologist*
- Social Worker
- Dietitian
- Nurse Case Manager
- Plastic Surgeon

Surgery

- **Curative**- complete tumor removal
  - Tumor site and margin of tissue
    - Goal is a clear margin (tumor cells are > 1 cm from margin)
  - Lymph nodes
- **Palliative**
  - Relieve pain
  - Correct obstruction

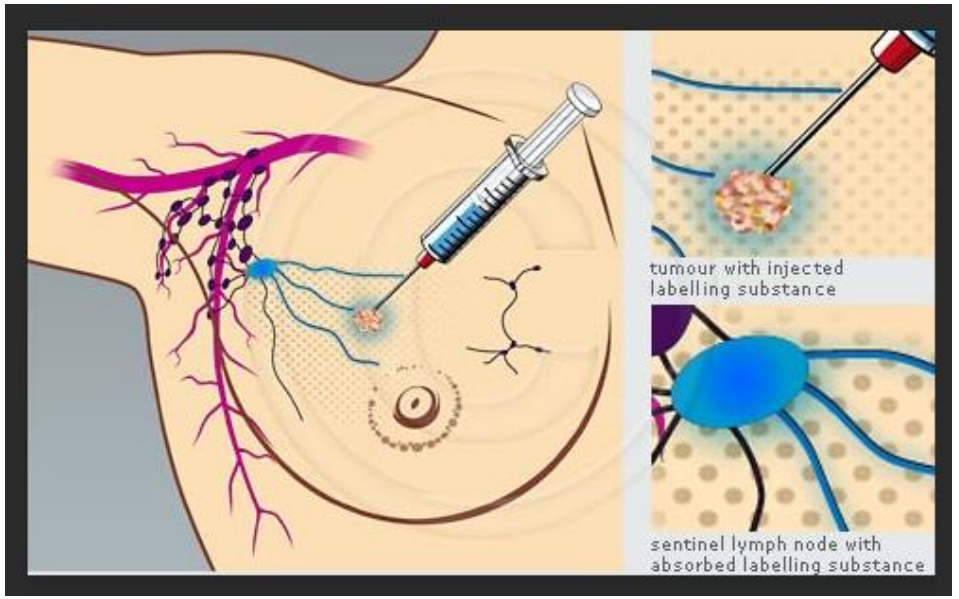
Surgical Margins



www.breastcancer.org

Lymph Node Dissection

- **ALND**
  - Remove at least 6 of the lymph nodes
- **SLND**
  - Determine which nodes are 1st to receive drainage from the breast
  - 1-3 sentinel nodes are removed



Sentinel Lymph Node Biopsy

- Reduces clearance of lymph nodes
- Reduces secondary morbidities
  - Seroma
  - Lymphedema
  - ROM restrictions
  - Slow wound healing
  - Functional restrictions

Kretchner et al *Melanoma Res 2008*

Chemotherapy

Chemotherapy

- Drug Administration- systemic for wide control
  - Oral
  - Subcutaneous
  - Intramuscular
  - Intravenous (hickman and picc catheters)
  - Intrathecal (within the spinal canal)- more local
  - Intraperitoneal- more local
- Intermittent doses allow for bone marrow recovery
  - 3 week recovery time for blood counts
  - Dose-Dense – increases density of delivery q2 wks

Chemotherapy

- **Adjuvant Therapy**
  - Treatment introduced following surgery
  - Typical administration
- **Neo Adjuvant Therapy**
  - Treatment introduced PRIOR to surgery
  - Indicated if the tumor is
    - Large
    - Compromising

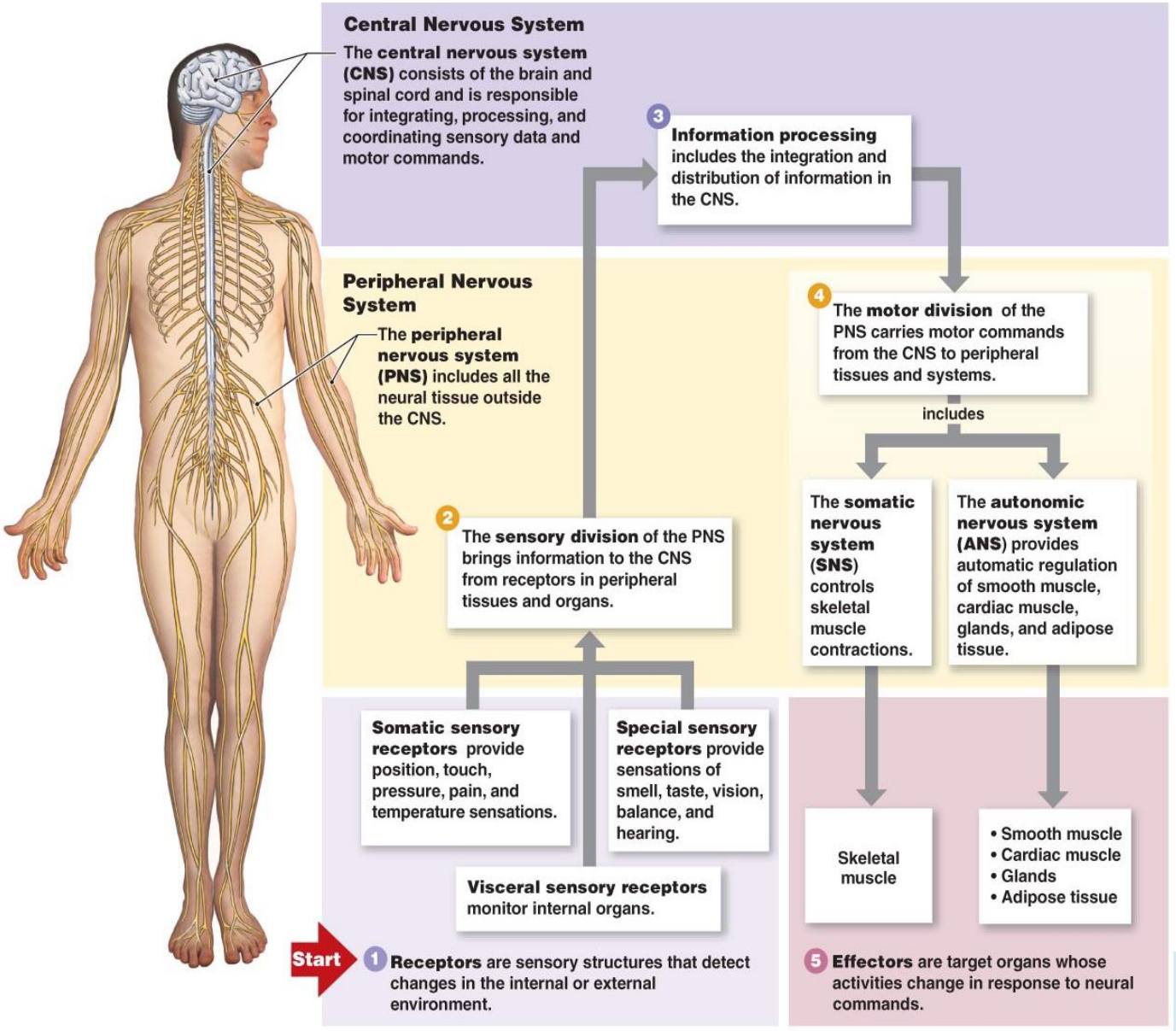
Chemotherapy

- Goal is to affect cancer cell proliferation by damaging DNA with least possible harm to normal cells
- Prevents metastatic disease
- Impacts rapidly dividing cells
  - Cancer cells
  - Epithelial cells
    - Mucous membranes, hair, nails

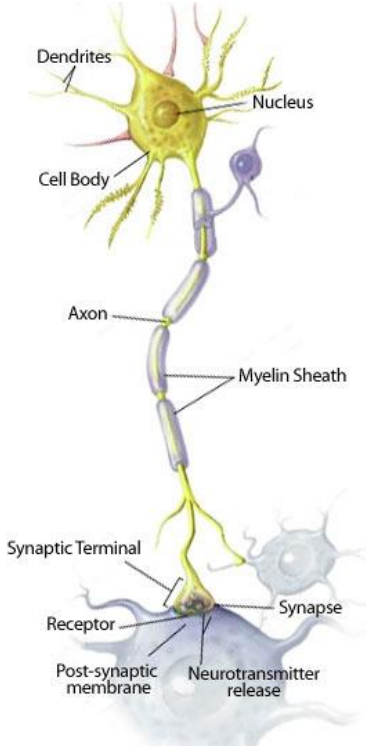
Chemotherapy

- Greater than 50 agents with differing mechanisms and various side effects
- Typically agents are combined for greatest effect
  - Impact metabolism of cells
  - Impact the RNA
  - Impact the ability of the cell to produce energy
  - Impact blood flow to the tumor

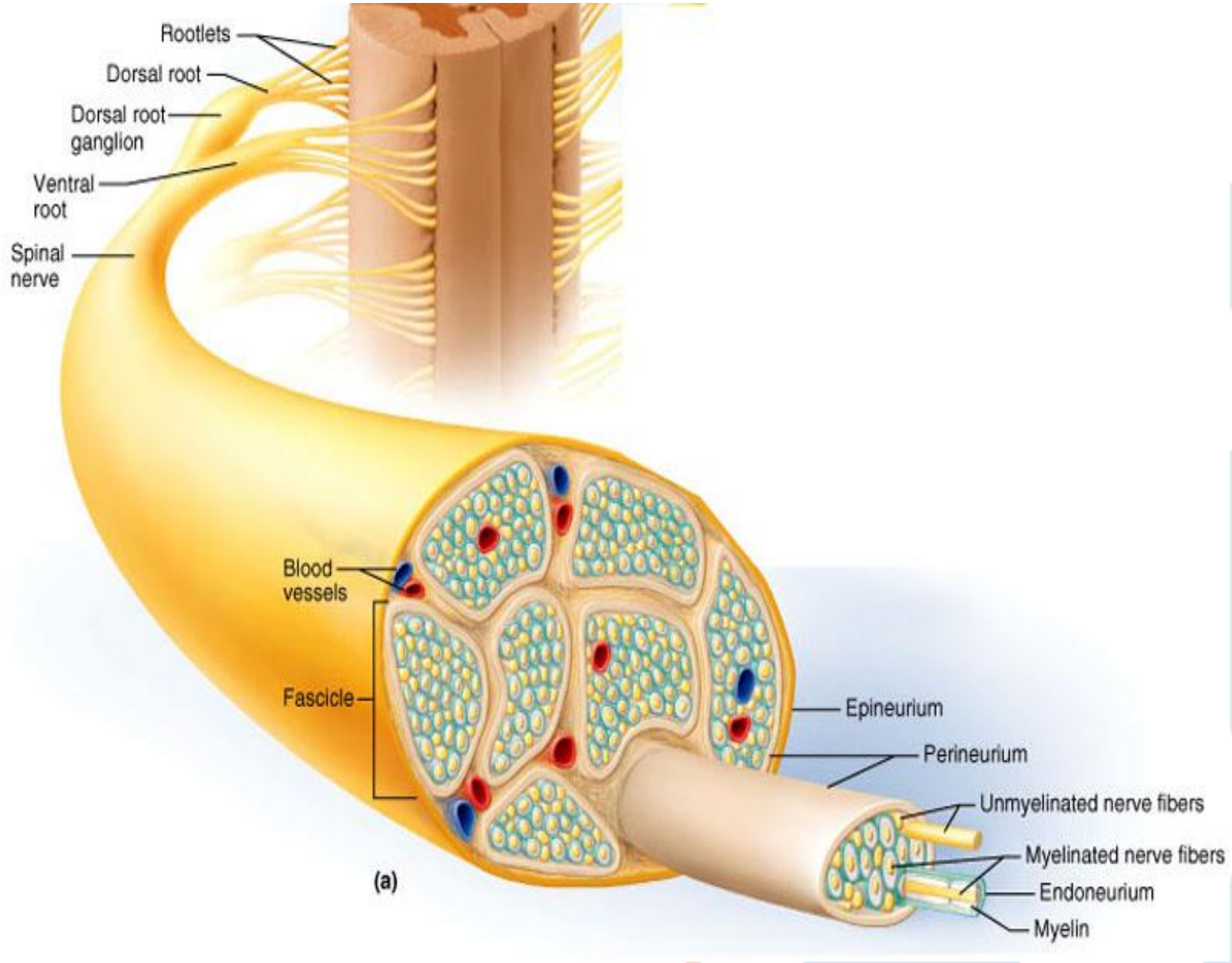
Major Components of the Nervous System



Neuron Structure

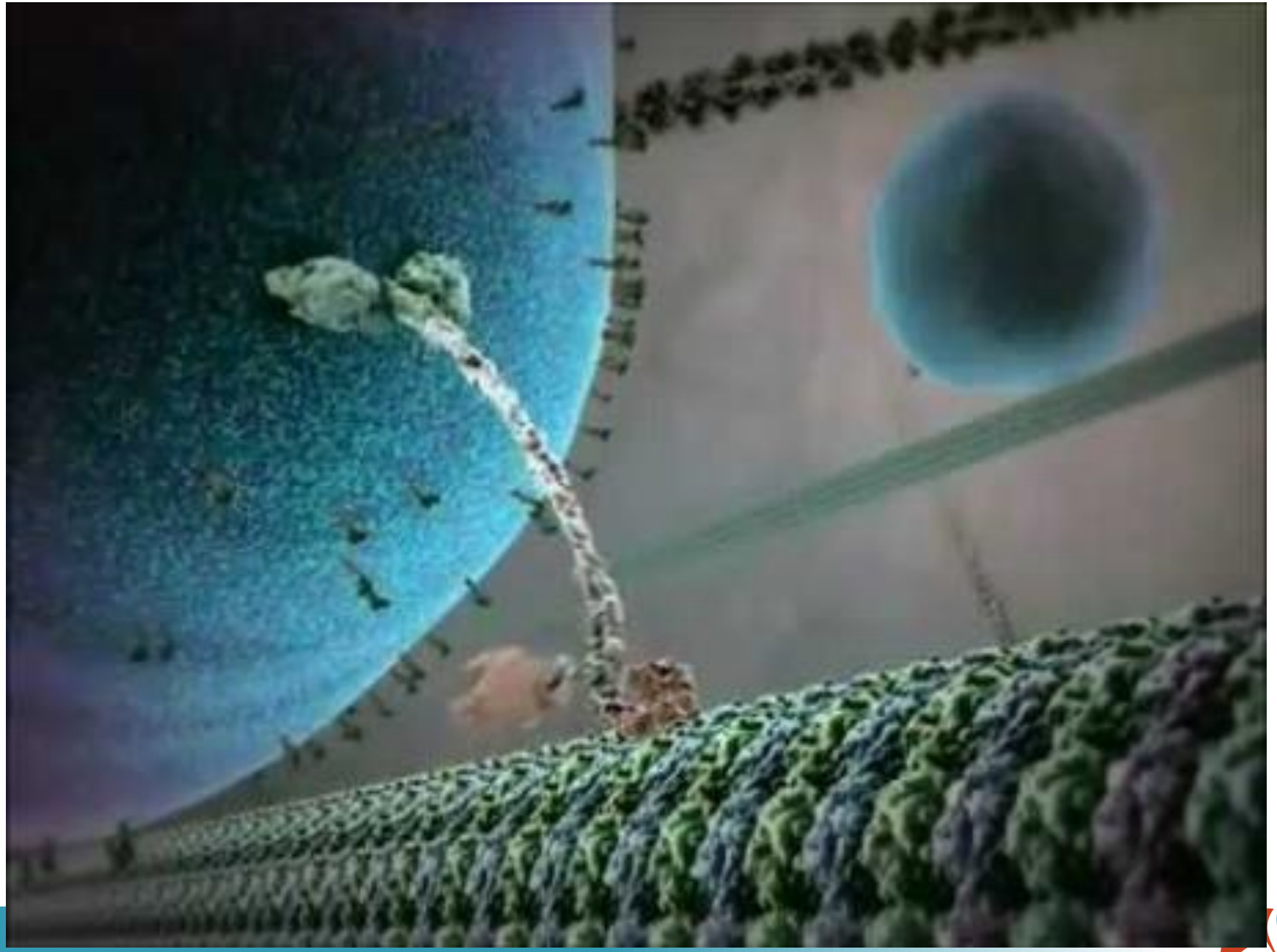


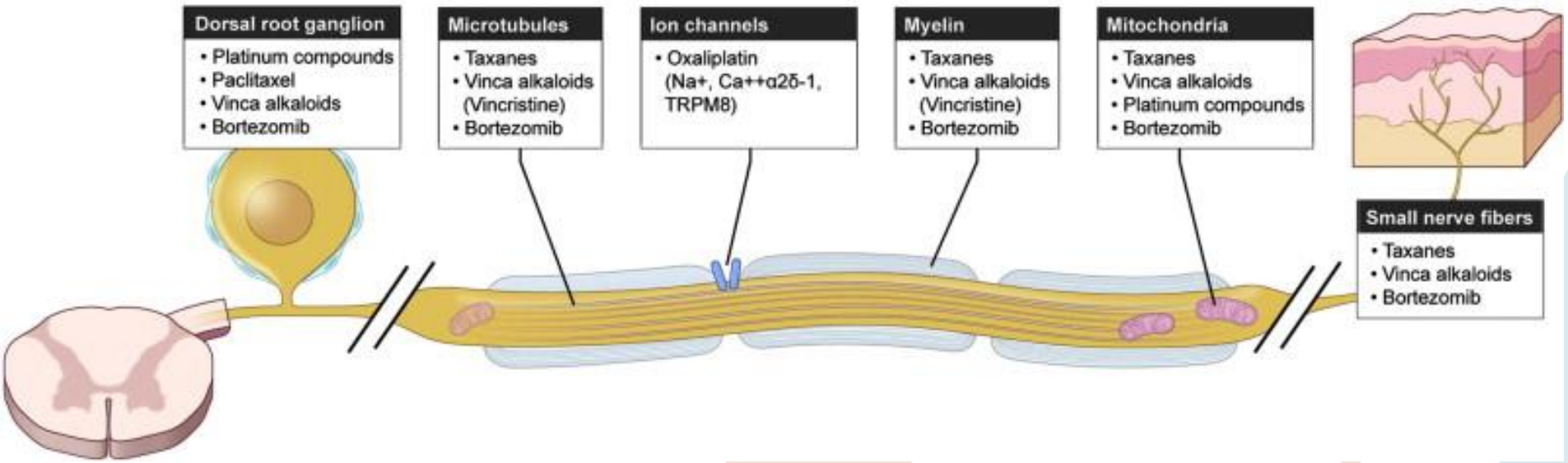
- Most of neurons organelles (including its nucleus) are located in its cell body
- 2 types of extensions arise from the cell body
  - Numerous **dendrites:** receive signals
  - A single **axon:** transmit signals
    - Axon hillock: conical region of axon where it joins cell body, and that typically generates the signal that travels the length of the axon
    - Myelin sheath: mostly lipid layer that insulates the axon


Rootlets
Dorsal root
Dorsal root ganglion
Ventral root
Spinal nerve
Blood vessels
Fascicle
Epineurium
Perineurium
Unmyelinated nerve fibers
Myelinated nerve fibers
Endoneurium
Myelin
(a)

Neurons and Microtubules

- The size, shape, and compartmentalization of neurons must be generated and supported by the cytoskeletal systems of intracellular transport.
- One of the major systems is the microtubule-based transport system along which kinesin and dynein motor proteins generate force and drive the traffic of many cellular components.
- If microtubules loose their dynamic instability and become fixed, neurons will be unable to transport vesicles around the cell

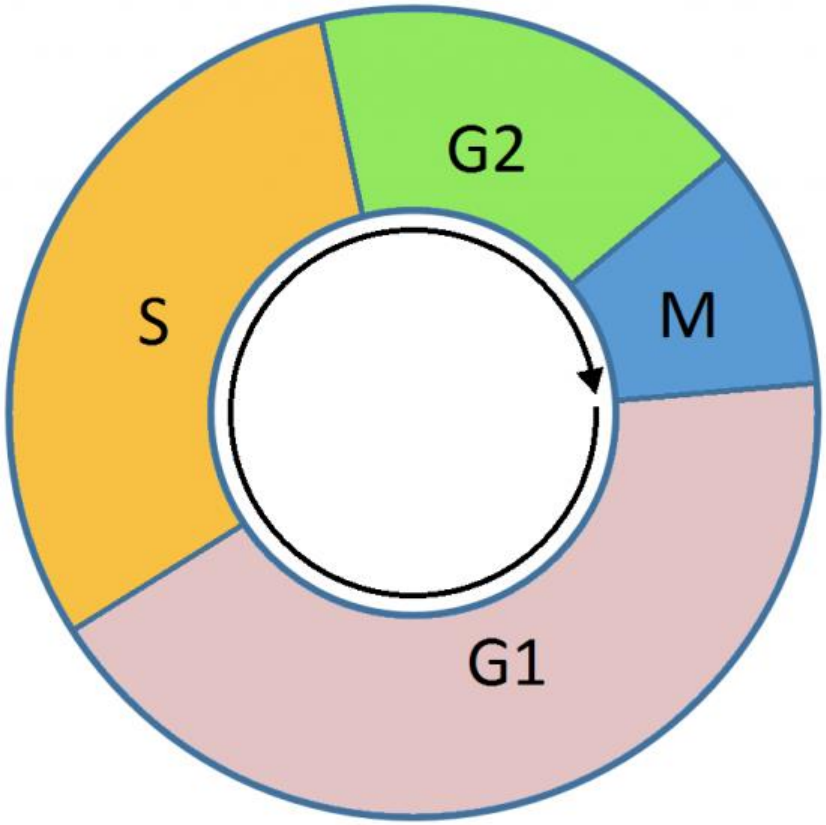




Wang, et al 2012

CIPN Myelin Theory

- CIPN can develop as a result of damage to the myelin covering through drug-induced free radical production in an around the nerves.
- Nerves with damaged myelin cannot send signals properly.
  - Numbness occurs when nerves are no longer transmitting a signal
  - Tingling happens if a false signal is sent
  - Pain is felt when information overloads your unprotected nerves



G1 - Growth

S - DNA synthesis

G2 - Growth and preparation for mitosis

M - Mitosis (cell division)

Image Source: Wikimedia Commons

Alkylating Agents

- Oldest class of anti-cancer drugs
- Active or latent nitrogen mustards
- All share a common mechanism of action but differ in their clinical activity
- Alkylination of the DNA leads to DNA strand breaks and DNA strand cross-linking
- Chemotherapy drugs are active in every stage of the cell cycle
- Use in both solid tumor cancers and leukemia
- Can cause secondary cancers (most common Acute Myeloid Leukemia)
- Examples: Cytoxin, Ifex, Alkeran, Thioplex etc…

Antimetabolites

- Interfere with normal metabolic pathyways, including those necessary for making new DNA
- Methotraxate is the most widely used antifolate
  - Inhibits a crucial enzyme required for DNA synthesis, exerts its effect on the S phase of the cell cycle
- 5 – Fluoroacil is the second most used
  - Thwarts DNA synthesis by interfering with the nucleotide production
  - Some patients can lack the enzyme DPD and become toxic due to the inability to metabolize the drug

Anthracyclines

- Works by the formation of free radicals
  - Results in DNA strand breaks and subsequent inhibition of DNA synthesis and function
- Also inhibit the enzyme topoisomerase by forming a complex with the enzyme and DNA
- This class is not cell cycle specific
- Most important side effect of this class is cardiac toxicity
- Doxorubicin – was found from an mutated strand of fungus
- Examples: Idarubicin, Epirubicin (Ellence), Mitoxantrone (Novantrone)

Vinca Alkaloids

- Leaves of a periwinkle plant (Vinca rosea), initially used to make tea that improved diabetes
- The drug binds to the tubulin and leads to the disruption of the mitotic spindle apparatus.
- These drugs specifically work during the M phase
- Examples: vincristine, vinblastine, and vinorelbine

Taxanes

- Compounds were first isolated for the bark of the Pacific yew tree in 1963
- Specific for the M phase of the cell cycle
- They bind with microtubules and inhibit their normal function
- Most common side effect is lowering of the blood cells
- Examples: Taxol, Taxane

Platinums

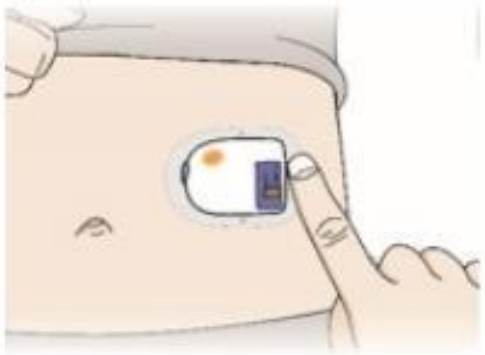
- Natural metal derivatives
- Work by cross-linking DNA subunits, which inhibit DNA synthesis, transcription and function
- Can act in any cell cycle
- Most significant toxicity is kidney damage
- Examples: Cisplatin, Carboplatin and Oxaliplatin

Treatment for Neutropenia = Neupogen or Neulasta

- To speed up the recovery and activity of WBCs
- This drug is a "colony-stimulating factor" (CSF)
- Two CSFs are used to increase the WBC count
- Given according to the weight of the patient and the level of bone marrow recovery
- Side Effects: bone pain in the sternum or hips
- May take acetaminophen or a non-steroidal analgesic (ibuprofen, naproxen) if necessary

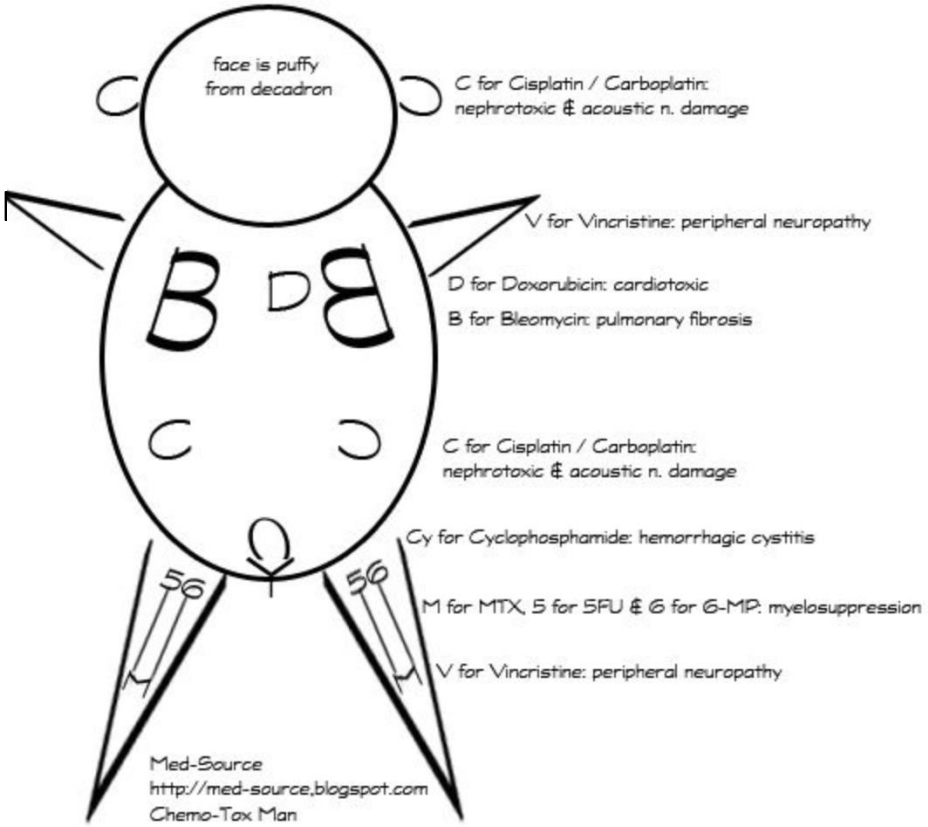
Back of upper arm (triceps)
Vertical with the light facing down toward the elbow

Abdomen
Horizontal with the light facing up and visible to the patient



Local and Systemic Effects Chemotherapy

- Chemotherapy
  - Diarrhea
  - Bone marrow suppression
  - Skin rashes
  - Phlebitis
  - Alopecia



Side Effects of Chemotherapy

- Nail changes
- Mouth sores
- Loss of appetite
- Nausea or vomiting
- Menstrual changes & fertility issues

- *Fatigue*
- *Neuropathy*
- Chemo brain
- *Heart damage*

deJong et al 2002, Sitzia and Huggins 1998

Toxicities

- Cardiotoxicity
  - Left Ventricular Dysfunction
  - Lower left and right ejections fractions
  - Abnormal left ventricular contractility
  - Reduced cardiac output and stroke volume
  - Leads to lower oxygen and nutrient delivery
- Exercise
  - Strengthens myocardium
  - Increases cardiac output and stroke volume
  - Decreases resting heart rate
  - Lowers exercise heart rate

Toxicities

- Pulmonary
  - Decreased total lung capacity
  - Decreased diffusion capacity
  - Less intake of oxygen, lower removal of carbon dioxide
  - Decreased submaximal and maximal exercise oxygen consumption
- Exercise
  - Strengthens intercostal muscles
  - Improves ventilation and transport of air from the environment to the cellular level

Toxicities

- Muscular
  - Muscle wasting
  - Destruction of skeletal muscle
  - Increased muscle weakness
- Exercise
  - Increases integrity of muscle tissue
  - Increases protein synthesis
  - Stimulates the release of hormones that increase muscle cell growth and development
  - Improves metabolism which increased the efficiency of energy utilization

Toxicities

- Neurotoxicity
  - Slows motor function
  - Decreases coordination
  - Peripheral neuropathy
- Exercise
  - Enhances motor unit recruitment
  - Improves neurochemical availability at the cellular and tissue levels
  - Improves coordination
  - Improves peripheral neuropathy and increases motor neurons

Toxicities

- Gastrointestinal
  - Diarrhea, vomiting, loss of appetite
  - Loss of body nutrients
  - Loss of body fluids and electrolytes
  - Alters metabolism
- Exercise
  - Increases uptake of nutrients
  - Improves weakness and fatigue
  - Improves appetite

Toxicities

- Myelosuppression
  - Inhibits bone marrow function
  - Lowers red blood cells (anemia)
  - Loss of oxygen carrying capacity
  - Heart has to work harder
- Exercise
  - Increases red blood cell production
  - Increases blood volume
  - Increases hemoglobin concentration

Radiation

ACADEMY of ONCOLOGIC PHYSICAL THERAPY
Knowledge | Compassion | Practice | Results

Radiation therapy

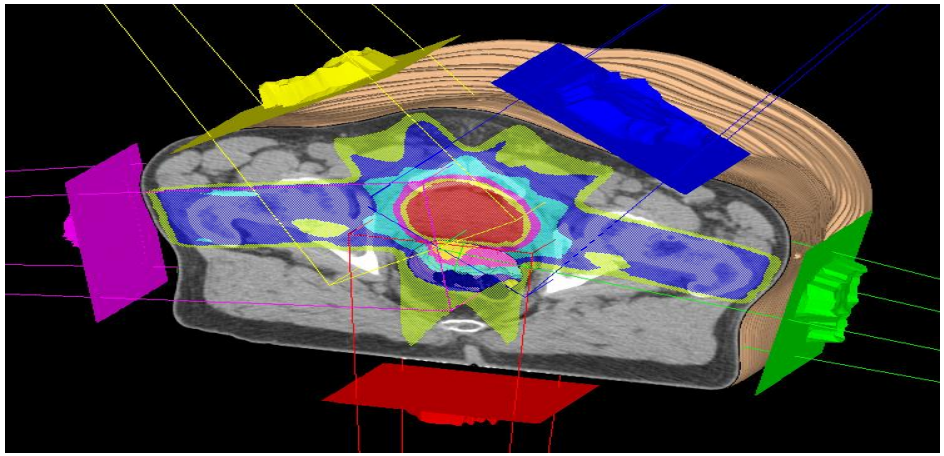
- Destroys local cancer cells by inhibiting cell growth and division
- **Neo-adjuvant**- to shrink tumors
- **Adjuvant**
  - to kill remaining cells at primary site to prevent recurrent disease
    - Importance of surgical margins
  - Prevent residual cancer cells from metastasizing
- **Palliative**- shrinks metastatic lesions
  - Preserve bone integrity
  - Pain management
  - Prevention/alleviation of nerve entrapment

Radiation Therapy
External Beam

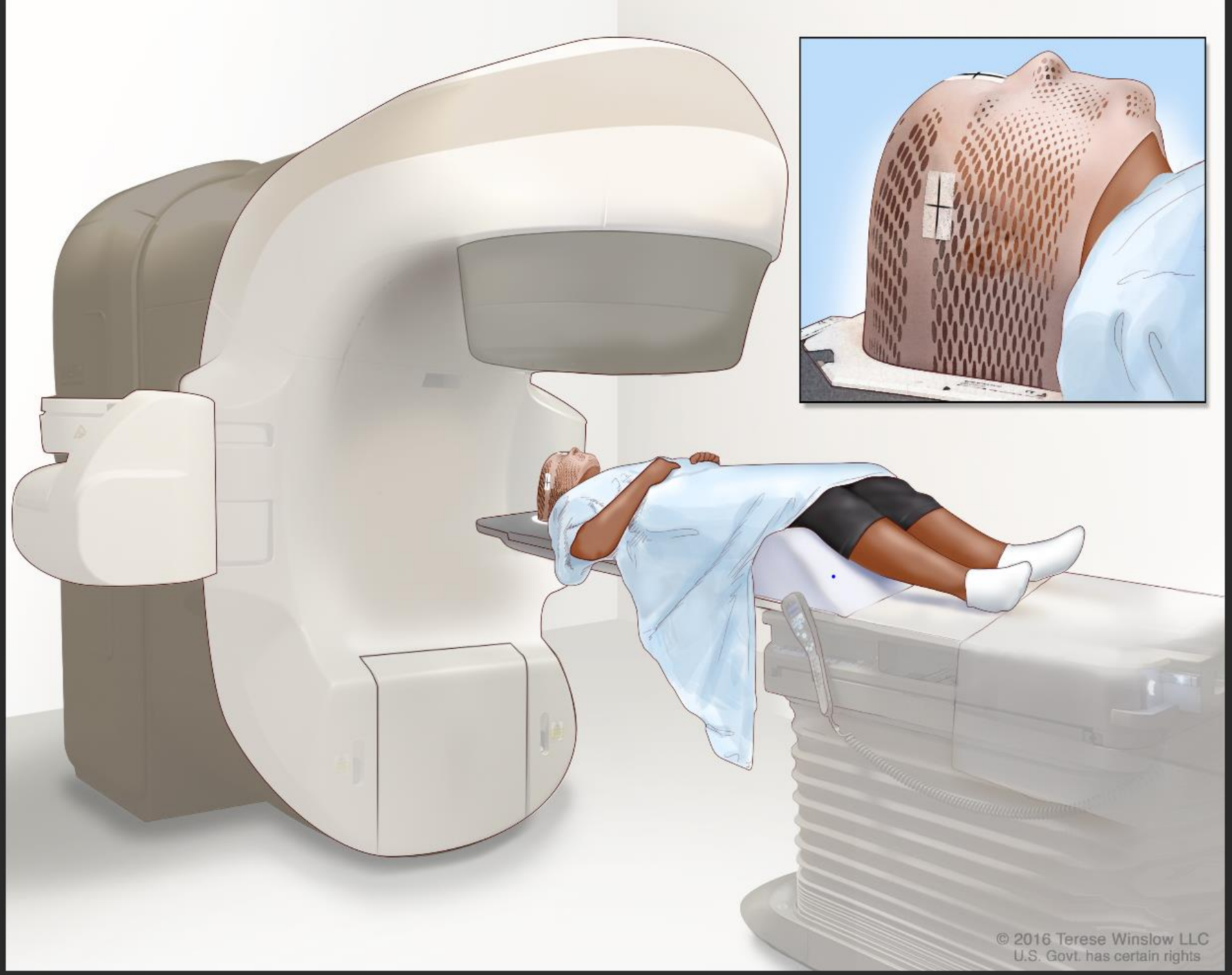
- Simulation
  - Positioning and Tattooing
- Treatment
  - Delivered in tangential fragmented beams
    - Full daily dosage is broken down and delivered in tangents with full dose culminating at the site of the tumor
  - 5-10 minutes
  - Daily over 4-6 weeks

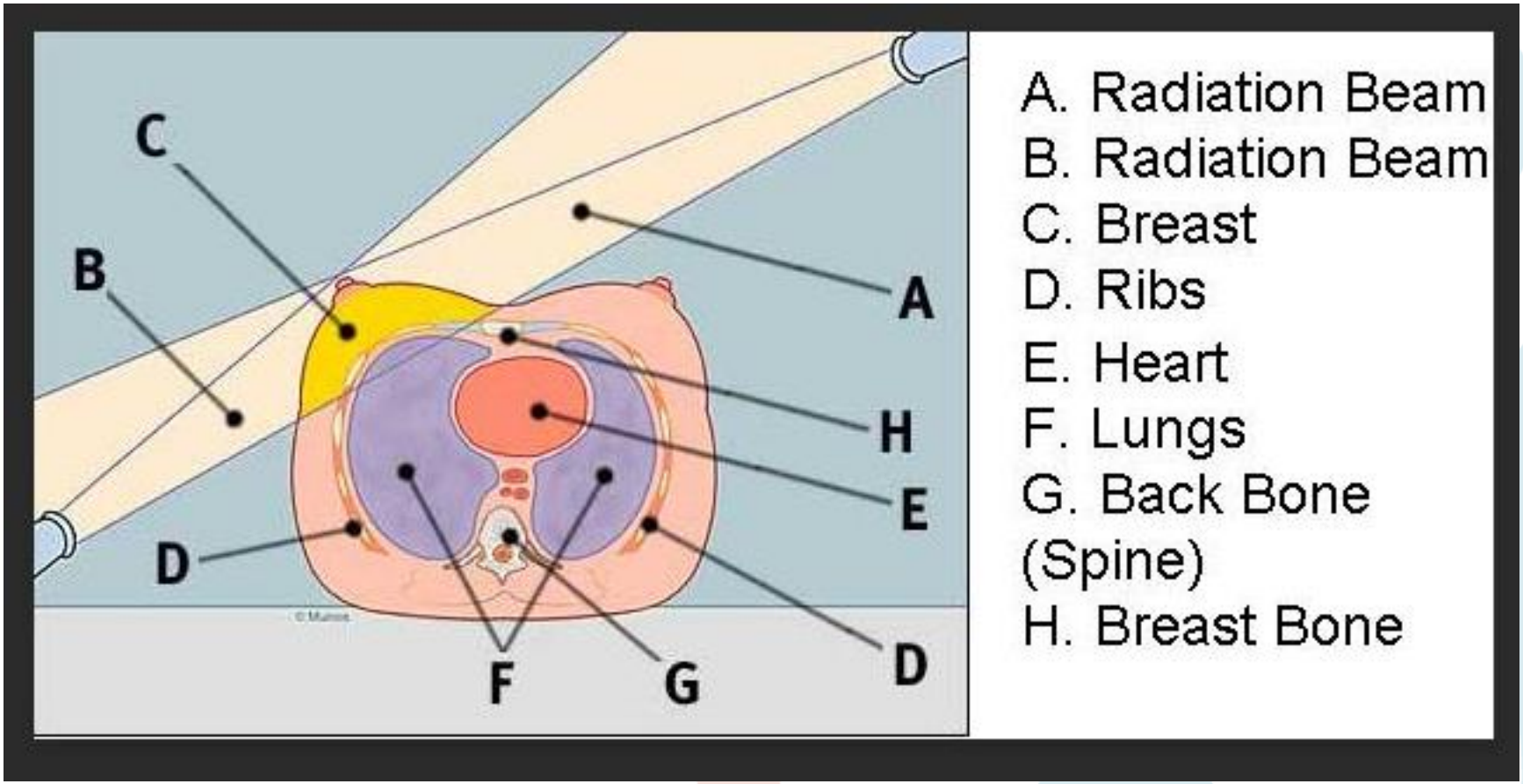
External-Beam Radiation

- Intensity-modulated radiation therapy (IMRT)
  - CT scan; beams converge with highest dose over tumor
- Image-guided radiation therapy (IGRT)



http://drrajurao.com/imrt.html


© 2016 Terese Winslow LLC
U.S. Govt. has certain rights


C
B
A
H
E
D
F
G
D
A. Radiation Beam
B. Radiation Beam
C. Breast
D. Ribs
E. Heart
F. Lungs
G. Back Bone (Spine)
H. Breast Bone

Radiation Therapy

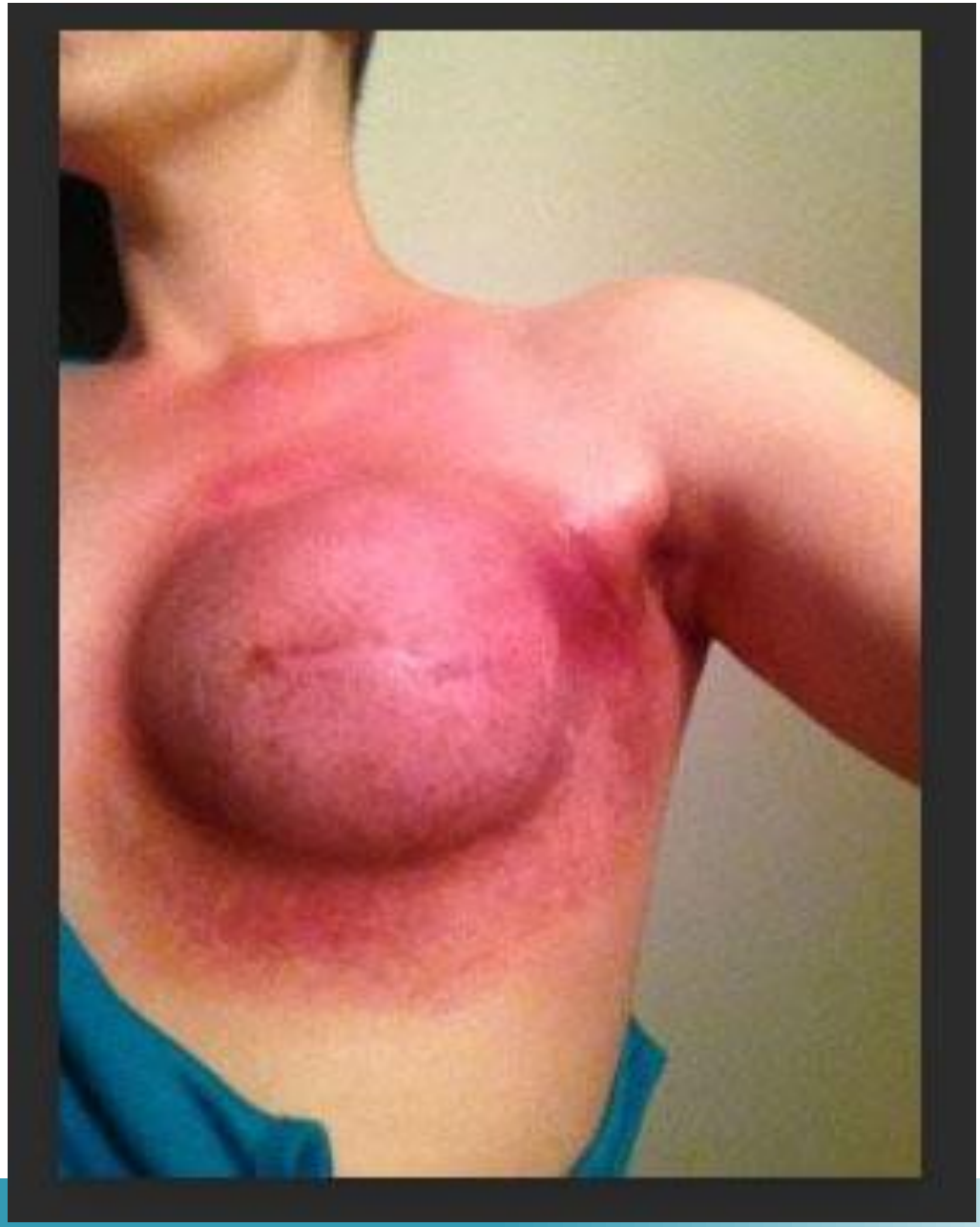
- Given in daily dosages over 4-6 week period
- Measured in Gy
  - 40 Gy + - effects on skin
  - 50 Gy + - effects on bone
  - 60 Gy + - effects on soft tissue (fascia)
  - 70 Gy + - effects on muscle and tendon

Radiation Therapy and Skin Impairment

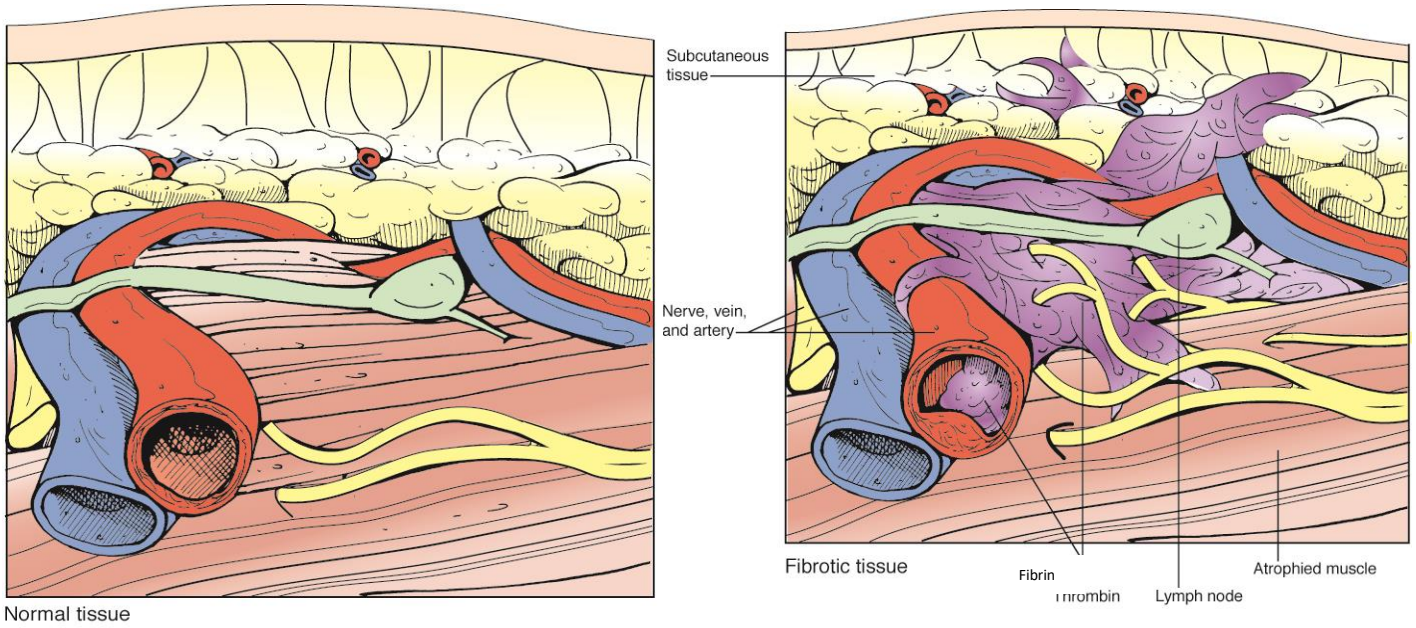
Effects classified in stages:

- **Acute**: (1-4mos)- desquamation and healing of superficial tissue
- **Sub acute**: (4-12mos)- microcellular changes, fibrosis of vasculature and lymphatics, adhesions to collagen
- **Chronic**: (1-8+yrs)- progressive immobility and adhesion of tissue

Cooper et al., Int J Radiat Onc Biol Phys 1995



Radiation Therapy Side Effects



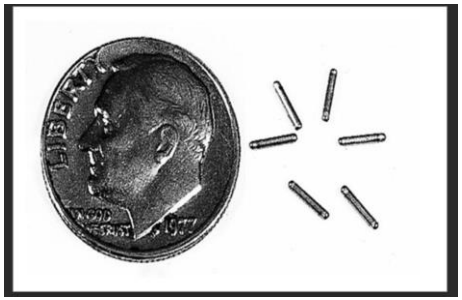
Radiation Precautions During Treatment

- Use only lukewarm water and mild soap. Let water run over the treated area. Do not rub.
- Do not wear tight clothing over RX area.
- Try not to rub, scrub, or scratch any sensitive spots.
- Avoid putting heating pads or ice packs, on treated skin.
- Avoid any powders, creams, perfumes, deodorants, body oils, ointments, lotions, or home remedies not approved by your doctor.
- Avoid exposing the area to the sun during Rx.

Radiation Therapy
Brachytherapy

- Internal delivery of radiation
- Delivered directly to the tissues
  - Seeds
  - Wires
  - Ribbons
- May be in place for hours, days or may be permanent

Internal Radiation aka “Brachytherapy”



- Small seeds
  - Typically placed with ultrasound guidance
- Interstitial brachytherapy
  - Implantation of radioactive needles or other sources directly into and around tissue to be irradiated
- Intracavitary brachytherapy
  - Uses an applicator to introduce radioactive sources into natural or surgical body cavities
- Episcleral brachytherapy
  - Small metallic “plaque” containing sealed radioactive sources is temporarily placed on the eye adjacent to the tumor.

MammoSite

- Soft balloon attached to a thin catheter placed inside the lumpectomy cavity
- A tiny radioactive seed is inserted; delivers radiation from inside the breast
- Focused and specific to malignant tissues
- Daily treatment is only a few minutes long
- Entire treatment is given in five days instead of seven weeks
- Outpatient based

Cyberknife

- High dose radiation therapy
- Directed to tumors
  - Difficult to reach with surgery
  - Poor candidate for surgery
- Currently used with
  - Lung
  - Spinal
  - Pancreatic
  - Liver
  - *Prostate*

Local and Systemic Side Effects Radiation Therapy

- Immunosuppression
- Soft tissue fibrosis
- Burns
- Delayed wound healing
- Edema
- Pain
- Limitations in ROM (breast cancer)

Other Cancer Treatments

ACADEMY of ONCOLOGIC PHYSICAL THERAPY
Knowledge | Compassion | Practice | Results

Biological Therapy

- Vaccines to help fight cancer or control side effects
- Side effects
  - Fever
  - Chills
  - Nausea
  - Vomiting
  - Anorexia
  - Fatigue
  - Fluid retention

Anti-angiogenic Therapy

- **Angiogenesis**
  - The formation of new blood vessels
  - Plays an important role in the growth and spread of cancer
  - New blood vessels “feed” the cancer cells
- **Antiangiogenic agents**
  - Chemicals that prevent or slow down the growth of cancer by blocking the formation of new blood vessels

Antiangiogenic Agents

- Advantages
  - Mild side effects
  - No tendency towards resistance (short and long term)
  - Effective and safe in combination with chemo and XRT
- Disadvantages
  - Keeps tumors stable rather than killing them
    - may need to be administered over a long period
- Side Effects:
  - Delayed wound healing
  - Excessive blood clotting or bleeding
  - HTN exacerbated
  - Fetal damage if used during pregnancy

Hormonal Therapy

- Hormone therapy is another form of systemic therapy
- Used as an adjuvant therapy to reduce the risk of recurrence after surgery
- Hormonally driven cancers
  - Breast
  - Prostate

Hormonal Therapy

- Only effective in hormone receptor + cancers
- Estrogen promotes the growth of hormone receptor + cancers
- Hormonal therapies strive to prevent the sex hormone from impacting the cell
  - **Modulate the availability of the receptor**
  - **Prevent the hormone from being made**

Hormonal Therapy Side Effects

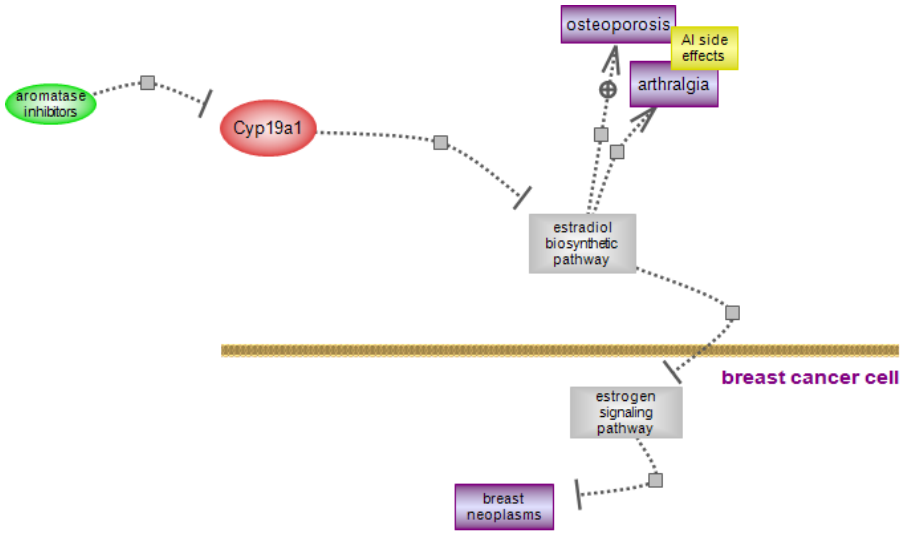
- Gastrointestinal symptoms
- Hypertension
- Weight gain
- Hot flashes and sweating
- Altered mental status
- Impotence
- Bone mineral density loss and osteoporosis
- **Joint Arthralgias**
- Loss of muscle mass

Aromatase Inhibitors (AIs)

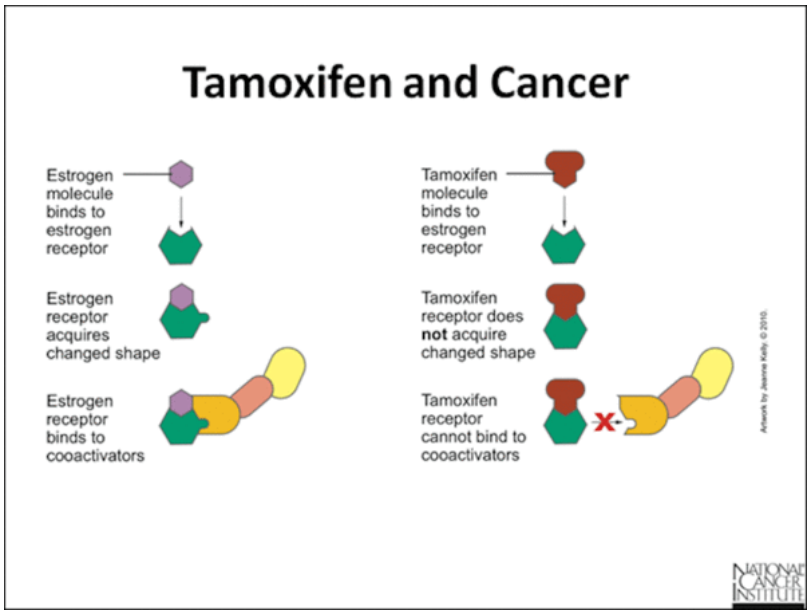
- Stop estrogen production
- Most useful in women who are past menopause
  - After menopause, a small amount of estrogen is still made by an enzyme (called aromatase)
- Examples: Femara, Arimidex, Aromasin
- Side effects: muscle pain and joint stiffness &/or pain, bone thinning

Stout et al 2015

Aromatase Inhibitors (AIs)



ARIADNE



Targeted Therapy

- Drugs that block the growth and spread of cancer by interfering with specific molecules involved in tumor growth and progression.
- Precision medicine – uses info about a person's genes & proteins to prevent, diagnose & treat
- HER2-positive breast cancers
  - Example: Herceptin (Trastuzumab)
- BRAF melanomas
  - Example: Vemurafenib (Zelboraf®)
- Side effects – heart damage

Survivorship

ACADEMY of ONCOLOGIC PHYSICAL THERAPY
Knowledge | Compassion | Practice | Results

Who Are Cancer Survivors?

- Any person who has been dx. with cancer, from the time of dx. through the balance of life.
- At least 3 distinct phases associated with cancer survival:
  - Time from dx. to the end of initial treatment,
  - Transition from treatment to extended survival, and
  - Long-term survival (Mullan F, 1985).
- In practice, however, the term "survivor" is often used to mean someone who has finished active treatment.

(ACS definition from Cancer Treatment & Survivorship Facts & Figures 2014-2015)

Cancer Survivors

- Majority of cancer survivors (64%) dx. >/= 5 years ago
- 15% dx. 20 or more years ago
  - Have no evidence of cancer and have same life expectancy as a person who never had cancer,
    - however, late **physical complications and psycho-social complication**s of disease and Rx. are being recognized
  - Approximately 10-15% will have a cancer recurrence or a new cancer

Cancer Survivors with Highest Risk of Subsequent Cancers

- Adult survivors of Hodgkin lymphoma (e.g. risk of breast cancer) and
- Cancers related to tobacco use (cancer of the oral cavity and pharynx, lung and bronchus, kidney and renal pelvis, esophagus, and urinary bladder).
  - Individuals with a tobacco-related cancer are at increased risk of developing an additional tobacco-related cancer.
  - Continued smoking after treatment increases the risk of recurrence and smoking-related second cancers. (Parsons A, 2010; and Do KA, 2004)

Cancer Survivors

- Nearly half (46%) are 70 years of age or older
- 5% are younger than 40 years.
- About 80% of these cancer survivors, currently, almost 4 million people, are now receiving their cancer medical treatment in their own community hospitals.
- For the other individuals (about 20%) still in the 5 year window when risk of cancer spread or recurrence is high.
  - While many of these pts. receive their cancer medical care at specialized treatment centers; all of their other medical care is often delivered at their local community hospital.

"SEASONS OF SURVIVAL" (Mullan F, 1985)

- FIRST SEASON (acute survival): begins with Dx & facing mortality, dominated by CA Rx
- SECOND SEASON (extended survival): Rx & health care professionals' support ending watchful waiting/fear of recurrence
- THIRD SEASON (permanent survival/ cure): long-term secondary health effects, significant social problems (employment and insurance)

Breast, Prostate, Colorectal & Melanoma

ACADEMY of ONCOLOGIC PHYSICAL THERAPY

Knowledge | Compassion | Practice | Results

Breast Cancer

Female Breast Cancer

- Can begin in the milk ducts (ductal cancer) or glands that make breast milk (lobular cancer)
- Lifetime risk: 1 in 8 women (12%)
- In 2017:
  - 252,710 new cases of invasive breast cancer
  - 63,410 new cases of carcinoma in situ
  - 40,610 will die from breast cancer

Breast Cancer Facts

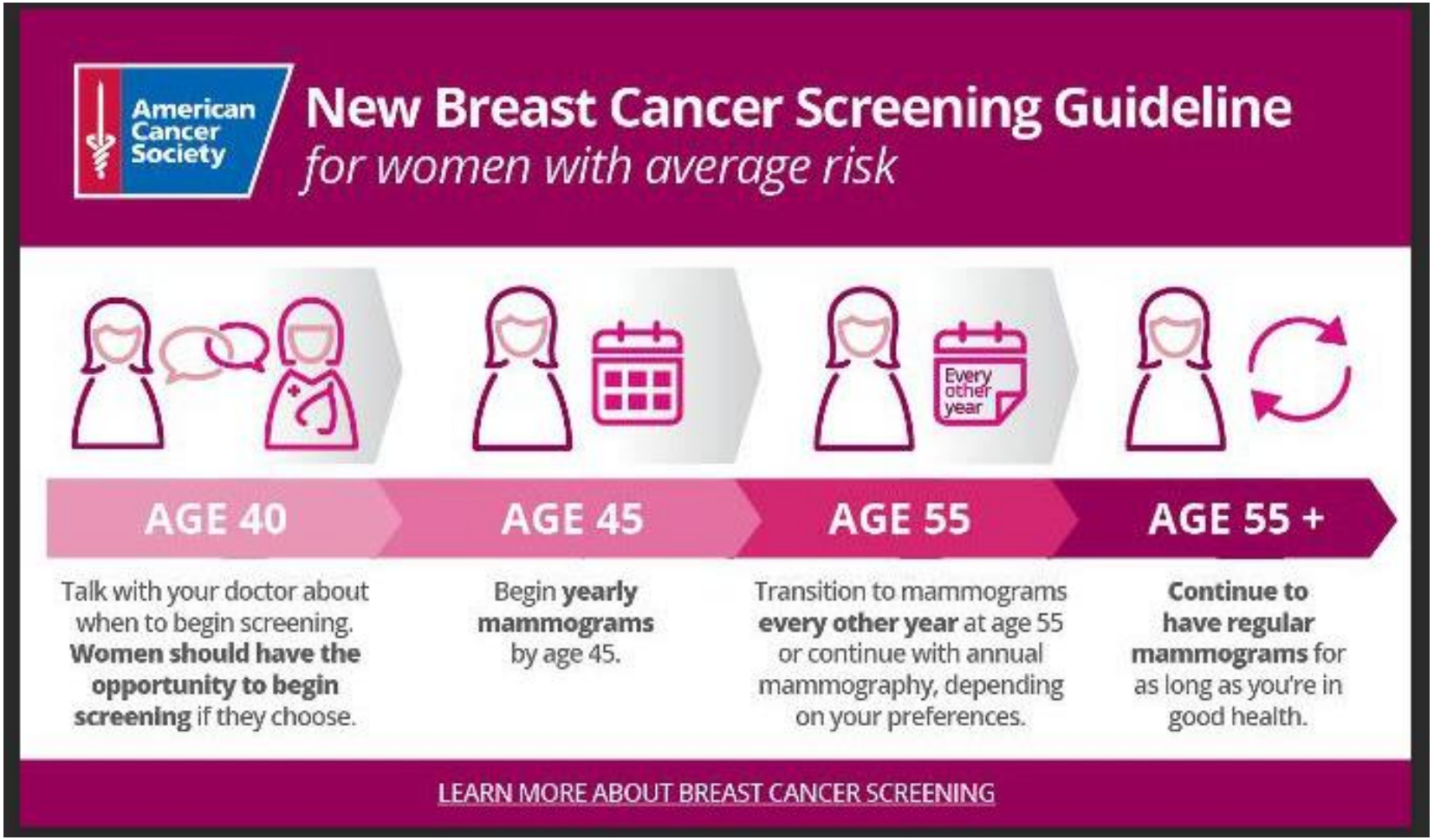
- 1:8 women
- Only 10-15% have family history
- BRCA 1 and BRCA 2 screening have lead to earlier detection and/or prophylactic surgery
- Stage I=95% survival rate
- Male breast ca is rare, but happens
- Treated with Aromatase Inhibitors (AI's) or Tamoxifen for 5 years after treatment completed

Female Breast Cancer Risk Factors

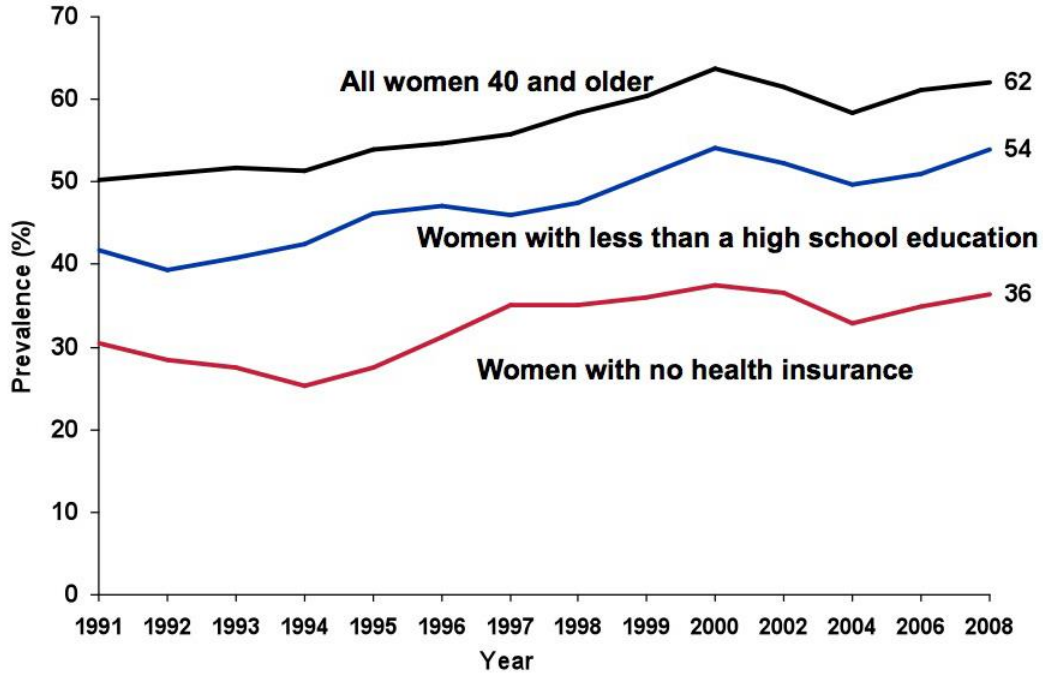
- Female
- Older
- Inherited genes
- Family history
  - <15%
- Drinking alcohol
- Being overweight or obese
- Physical inactivity

Screening Guidelines for Early Detection of Breast Ca

- Mammograms
  - Yearly starting at age 40
- Clinical Breast Exam
  - Every three years for women in their 20s and 30s
  - Every year for women 40 and older.
- Breast Self Exam
  - An option for women starting in their 20s.
- Women at increased risk (e.g., family history, genetic tendency, past breast cancer) should talk with their doctors
  - starting mammography screening earlier
  - having additional tests (i.e., breast ultrasound and MRI),
  - more frequent exams


American Cancer Society
New Breast Cancer Screening Guideline
for women with average risk
Every other year
AGE 40
AGE 45
AGE 55
AGE 55 +
Talk with your doctor about when to begin screening. Women should have the opportunity to begin screening if they choose.
Begin yearly mammograms by age 45.
Transition to mammograms every other year at age 55 or continue with annual mammography, depending on your preferences.
Continue to have regular mammograms for as long as you're in good health.
LEARN MORE ABOUT BREAST CANCER SCREENING

Mammogram Prevalence (%), by Educational Attainment and Health Insurance Status, Women 40 and Older, US, 1991-2008



***A mammogram within the past year. Note: Data from participating states and the District of Columbia were aggregated to represent the United States.**
Source: Behavior Risk Factor Surveillance System CD-ROM (1984-1995, 1996-1997, 1998, 1999) and Public Use Data Tape (2000 to 2008), National Centers for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, 1997, 1999, 2000, 2001-2009.

Types of Breast Ca

- Ductal Carcinoma=85%
  - Originates in the milk ducts
- Lobular Carcinoma=15%
  - Originates in the lobules
- Inflammatory
  - Typically dx in stage III
- Paget's
  - Rare
  - Peu d'orange appearance

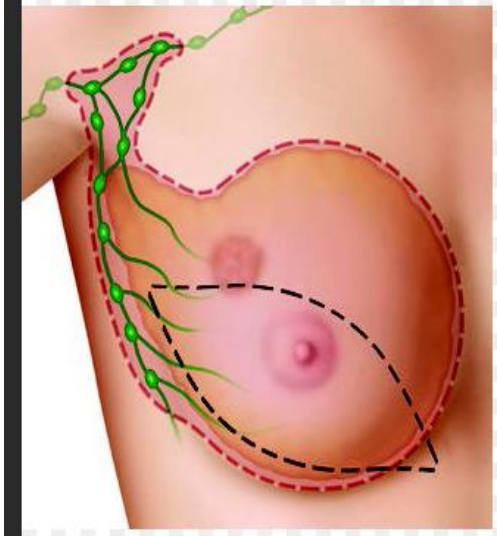
Breast Cancer Treatment

- Surgery
  - Lumpectomy
  - Node Dissection
    - Sentinel Lymph Node Biopsy (SLNB)
    - Axillary Lymph Node Dissection (ALND)
  - Mastectomy
  - Reconstruction
    - Breast
    - Nipple/Areolar
- Radiation
- Chemotherapy
  - Combination
- Hormone therapy
  - Block ER+/- or PR+/- to prevent growth of cancer
  - Aromatase Inhibitors (AI's)
  - Tamoxifen

Surgery-Mastectomy

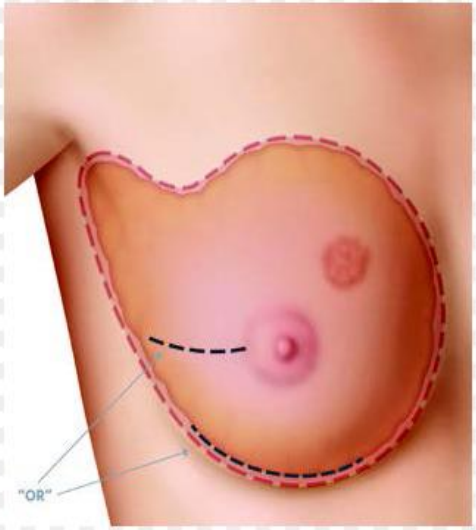
- Simple
- Modified radical
- Radical (Halstead)
- With or without reconstruction
  - With Reconstruction
    - Skin Sparing
    - Tissue Expander
    - Tissue Transfer

Simple Masctectomy



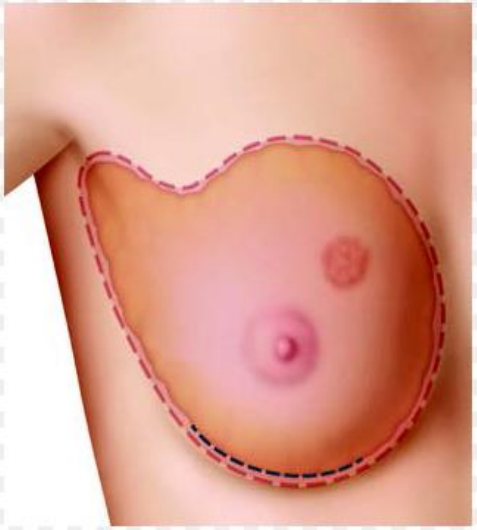
removes the breast tissue along with most of the skin, nipple and areola

Nipple Sparring Masctectomy



removes the breast tissue through a single incision while preserving the skin, nipple and areola

Hidden Scar™ Nipple Sparring Masctectomy



nipple-sparring surgery where the incision is made in the natural fold under the breast

black dashed lines = incision location

red shaded area within red dashed lines = tissue removed

Reconstruction-Tissue Expander

- Placement of temporary prosthesis underneath the pectoralis muscle
- Subcutaneous port with valve to inject saline solution
- Expanded over period of 4-8 weeks
- Surgically exchange permanent prosthesis/implant after expansion is complete

Implant Types

- Saline
- Silicone
- Cohesive silicone (Gummy Bear)

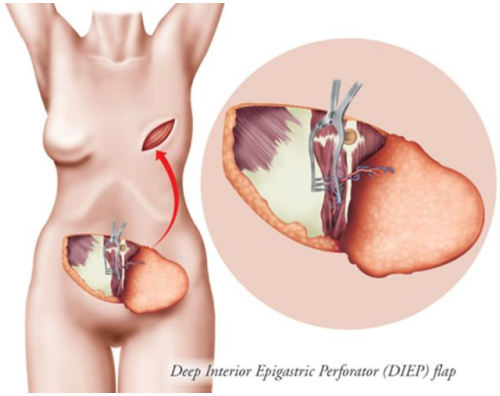
http://shannsoukup.buzznet.com/user/journal/

Reconstruction-Tissue Transfers

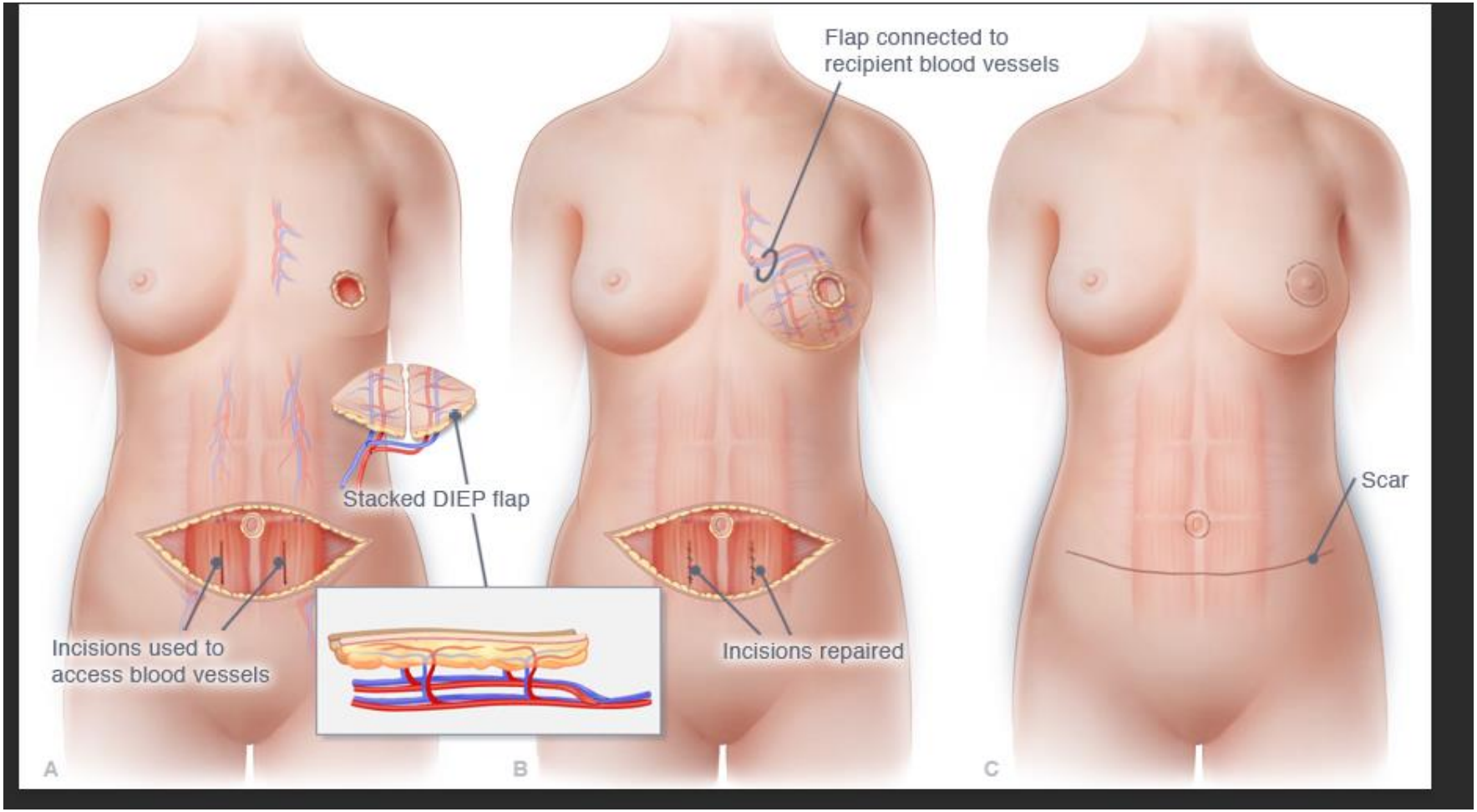
- Pedicle flap
  - Muscle, fat, blood supply stays connected, rotate and tunnel through to breast opening
    - Rectus
    - Latissimus
- Free flap
  - Muscle, fat, blood supply removed
  - Requires plastic surgeon skilled in microvascular anastomosis
    - Transverse Rectus Abdominus (TRAM)
    - Gluteal Flap

Reconstruction-Free Flaps

- DIEP
  - Deep inferior epigastric perforator
    - Short , thicker vessel
- SIEP
  - Superficial inferior epigastric perforator
    - Very short, thin, fragile, easily compromised ves

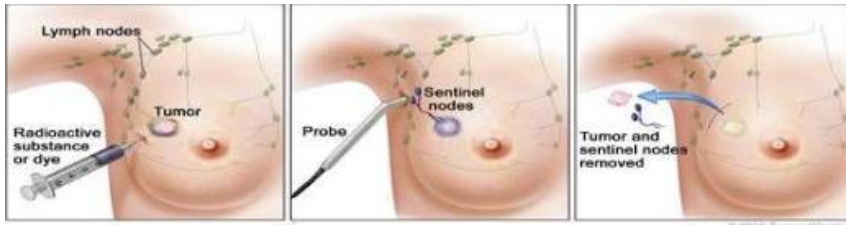


  - Common anastomosis sites for breast reconstruction flaps
    - Internal mammary
      - Close to sternum, more protected
    - Thoracodorsal
      - More lateral, less protected


Flap connected to
recipient blood vessels
Stacked DIEP flap
Incisions used to
access blood vessels
Incisions repaired
Scar
A
B
C

SLNB

- Inject blue dye into tumor bed
- Trace it to first few lymph nodes
- Test these during surgery
- If clean, no need to further dissect
- If +, then dissect further
- Spares number of lymph nodes removed
- Potentially decrease risk of lymphedema, but does not eliminate it; SLNB patients can develop lymphedema



http://www.slideshare.net/HasanRSh/breast-cancer-41687352

ALND

- More than 3 lymph nodes removed
- Can be upwards of 30-40
- Typically have post surgical discomfort
- If radiation needed, risk of lymph increases to 30%

https://academic.oup.com/asj/article/23/3/184/253141/Sentinel-Lymph-Node-Biopsy-in-the-Augmented-Breast

Scar Tissue s/p Mastectomy

ALND Scar

Cording s/p Mastectomy

Prevalence of Pain in Breast Cancer

- Etiology of pain may be from many causes (Ngamkham et al 2011)
- Localized pain (20% to 65%) (Lauridsen et al 2008, Rietman et al 2004)
- Pain may vary depending on treatment received
  - 43% reported pain after mastectomy (Smith et al 1999)
- Evidence suggesting changes in nociceptive gain
  - Damage to small nerve fibers during surgery (Gottrup et al 2000, Fernandez-Lao et al 2010)
- Presence of pain soon after surgery is a predictive factor for chronic pain after breast surgery (Perkins and Kehlet 2000)

Prehabilitation

- “[A] process on the cancer continuum of care that occurs between the time of cancer diagnosis and the beginning of acute treatment and includes physical and psychological assessments that establish a baseline functional level, identify impairments, and provide interventions that promote physical and psychological health to reduce the incidence and/or severity of future impairments.”

Silver J, Baima, J, Mayer, R. Impairment-driven cancer rehabilitation: an essential component of quality care and survivorship. *CA Cancer J Clin*, 63 (2013), pp. 295–317.

Inherent in cancer treatment…

- Known sequelae that have a deleterious impact on function, impacting a majority of patients
- An aggregate burden of impairment
- Short and long term impact on function
- Risk for impairment and recurrent disease
  - Low risk today ≠ Low risk tomorrow

Current Model of Care

- Focuses on treatment of the disease, followed by ongoing surveillance to detect recurrence of the cancer
- Limitations - it lacks attention to an individual's functional and physical well-being

Stout, NL, et al. 2012

Original Article

A Prospective Surveillance Model for Rehabilitation for Women With Breast Cancer

Nicole L. Stout, MPT, CLT-LANA[1]; Jill M. Binkley, PT, MClSc, FAAOMPT, CLT[2]; Kathryn H. Schmitz, PhD, MPH, FACSM[3]; Kimberly Andrews[4]; Sandra C. Hayes, PhD[5]; Kristin L. Campbell, PT, MSc, PhD[6]; Margaret L. McNeely, PT, PhD[7]; Peter W. Soballe, MD[8]; Ann M. Berger, PhD, RN, AOCNS, FAAN[9]; Andrea L. Cheville, MD[10]; Carol Fabian, MD[11]; Lynn H. Gerber, MD[12]; Susan R. Harris, PT, PhD[6]; Karin Johansson, RPT, Dr Med Sci[13]; Andrea L. Pusic, MD, MHS, FRCSC[14]; Robert G. Prosnitz, MD, MPH[3]; and Robert A. Smith, PhD[4]

Cancer April 15, 2012

Prospective Surveillance Model (PSM)

- Goals
  - 1) To promote surveillance
  - 2) To provide education
  - 2) To introduce rehabilitation and exercise
  - 3) To promote and support physical activity, exercise and weight-management behaviors
- Primary components
  - 1) Impairment identification & management
  - 2) Health-promoting skills and behaviors

Stout et al 2012

Components

Impairment

Identification & Management

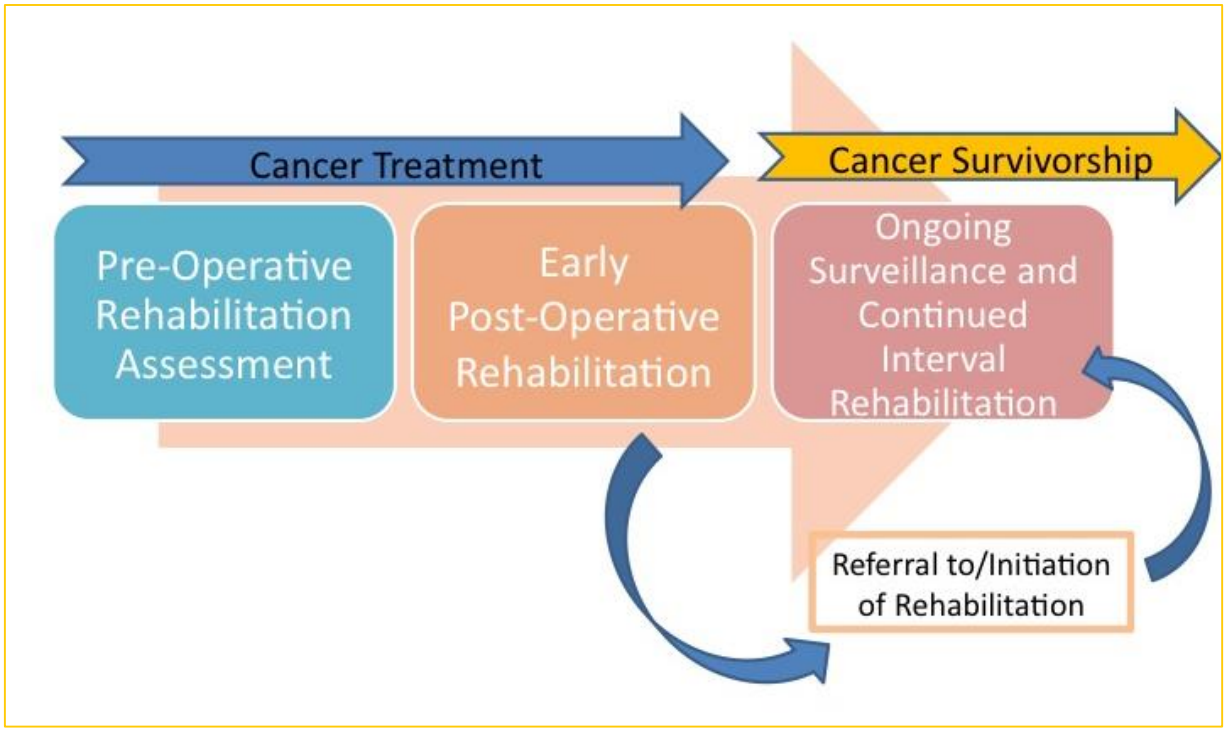
- Highlights common physical impairments seen at various intervals of disease management
- Coincide with standard follow up appointments
- Co-management approach

Facilitation of

Health-Promoting Skills & Behaviors

- Highlights assessment of patient's level of exercise, physical activity habits & functional status

PSM



Stout NL et al 2015

Preoperative Rehabilitation: Evaluation and Education

- Establish a baseline from which to follow the patient and detect change over time
- Upper extremity ROM, volume, strength, body weight, function, fatigue & level of physical activity and exercise should be assessed at the preoperative visit

Early Postoperative Rehabilitation: Reassessment and Exercise Program

- Take place within the first month after surgery
- Repeats baseline tests & measures
- Reinforces education: weight control, exercise & return to activity
- Patient education on prevention & early detection of common treatment-related impairments

Ongoing Surveillance

- Repeat baseline tests and measures
- If impairments are detected – initiate appropriate rehabilitation
- Proactive approach
- Promotes early intervention
- Ongoing education

Why prospective surveillance?

- Surveillance enables early detection of and intervention for treatment-related impairments
- Surveillance and intervention will decrease severity or prevent impairment and functional loss at all stages of disease management

Gerber et al 2012, Springer et al 2010, Stout et al 2008, Torres Lacomba 2010

Why Prospective Surveillance?

- Economic burden of cancer morbidity
  - World-wide cancer morbidity creates the largest economic burden on society
    - **This does NOT include the cost of treating cancer
  - 20% > heart disease
  - Greater than morbidity with HIV/AIDS and TB

ACS and LAF *The Global Economic Cost of Cancer.* Presented at UICC Cancer Congress 2010
http://www.cancer.org/AboutUs/GlobalHealth/global-economic-cost-of-cancer-report

Why Prospective Surveillance?

- A vision for physical therapy…
- Physical therapists are
  - Experts in movement dysfunction
  - Skilled in identification of impairments
  - Equipped with the knowledge and skills to treat physical impairments

EDGE Domains for Breast Ca

- Upper extremity function
- Shoulder and glenohumeral outcome measures
- Fatigue
- Pain
- Quality of Life
- Scapular assessment
- Lymphedema
  - QOL and functional outcomes

Upper Extremity Function

- Activity limitations and participation restrictions related to the inability to effectively use their UE (Yang et al 2010)
- Associated with poor QOL (Nesvold et al 2011)
- Related to decreased ROM and strength (Harrington et al 2013)

EDGE – Breast Ca (Recommended Measures)

- **Disabilities of Arm, Shoulder & Hand (DASH)**
- Shoulder Pain and Disability Index (SPADI)
- Shoulder Rating Questionnaire (SRQ)
- **University of Pennsylvania Shoulder Score (PSS)**

DASH

- Disabilities of Arm, Shoulder, and Hand
  - 30-item self-report questionnaire
  - All questions asked in the DASH require the use of the upper extremity
  - Most validated measure of upper extremity function in upper extremity disorders (Dowrick & Gabbe 2004)

	NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	UNABLE
1. Open a tight or new jar.	1	2	3	4	5
2. Write.	1	2	3	4	5
3. Turn a key.	1	2	3	4	5
4. Prepare a meal.	1	2	3	4	5
5. Push open a heavy door.	1	2	3	4	5
6. Place an object on a shelf above your head.	1	2	3	4	5
7. Do heavy household chores (e.g., wash walls, wash floors).	1	2	3	4	5
8. Garden or do yard work.	1	2	3	4	5
9. Make a bed.	1	2	3	4	5
10. Carry a shopping bag or briefcase.	1	2	3	4	5
11. Carry a heavy object (over 10 lbs).	1	2	3	4	5
12. Change a lightbulb overhead.	1	2	3	4	5
13. Wash or blow dry your hair.	1	2	3	4	5
14. Wash your back.	1	2	3	4	5
15. Put on a pullover sweater.	1	2	3	4	5
16. Use a knife to cut food.	1	2	3	4	5
17. Recreational activities which require little effort (e.g., cardplaying, knitting, etc.).	1	2	3	4	5
18. Recreational activities in which you take some force or impact through your arm, shoulder or hand (e.g., golf, hammering, tennis, etc.).	1	2	3	4	5
19. Recreational activities in which you move your arm freely (e.g., playing frisbee, badminton, etc.).	1	2	3	4	5
20. Manage transportation needs (getting from one place to another).	1	2	3	4	5
21. Sexual activities.	1	2	3	4	5

Notes: write, may or may not be dominant hand; may not be carrying object over 10 lbs due to surgical restrictions; may have hair loss – ask patient to simulate task

University of Pennsylvania Shoulder Score (PENN) (UPenn) (PSS)

- University of Pennsylvania Shoulder Score
  - 100-point shoulder-specific self-report questionnaire
  - 3 subscales: pain, satisfaction, and function
  - Higher scores on each subscale indicate increased function

Evaluation Considerations-Breast Ca Prehabilitation

- ROM
- Strength
- Arm Volume
- Co-morbidities
  - Diabetes
  - Cardiac
  - Shoulder dysfunction
  - Carpal tunnel
- Functional activities
- Recreational activities
- Falls/safety
- Caregiver support
- Objective Measures
  - EDGE taskforce recommendations
  - QOL surveys

Evaluation Considerations - Breast Ca

- Pain
- ROM
- Strength
- Arm Volume
- Palpation: skin integrity/scar/facial mobility
- Posture
- Neuropathy
- Balance/Falls
- Fatigue
- Upper-extremity dysfunction
- Joint arthralgia
- Weight gain
- Cardiovascular effects
- Osteoporosis

Evaluation Considerations-Breast Ca

- Objective Measures
  - EDGE taskforce recommendations
  - FACT (factit.org)
  - 6 MWT
  - TNS
  - Am Pac
  - BERG
  - DGI
- Referral to other disciplines
  - Cognition
  - Sexual health

Evaluation Considerations-Breast Ca

- Many woman avoid looking or touching scar
- Poor bra fit
- Anxiety
- Often have long and weak rhomboids, poor SA activation, tight pecs
- Chemotherapy side-effects
- Hormone therapy side-effects (AI's)
- Guarding and overworking UT
- Falls are not uncommon
- Physiological age accelerates for women undergoing ca treatment

Post-mastectomy Pain Syndrome

- Symptoms
  - Neuralgic quality pain associated with hypersensitivity, numbness, tingling
  - Muscle weakness may be present
  - Stimulus can be clothing, sheets irritating skin
  - 20-30% of women experience PMPS
- Theory
  - Intentional sacrificing of the intercostobrachial nerves
  - Neuropathies caused by chemo/radiation therapy

Treatment Considerations-Breast Ca

- Manual Therapy
  - MFR
    - Gentle mobilizations, be careful not to squeeze or pull implant
    - Do NOT mobilize gummy implants w/o specific instructions from surgeon; these can flip upside down
    - Separate fascial and breast tissues off rib cage
    - Dycem helpful for added traction (HEP)
  - Joint mobilizations (shoulder, clavicular and rib springing)
  - Manual lymph drainage (MLD)
    - Stimulates lymph system
    - Decreases congestion
    - Relieves pain
    - Improves pliability of tissue
  - Kinsiotape for scar or lymph flow

Treatment Considerations-Breast Ca

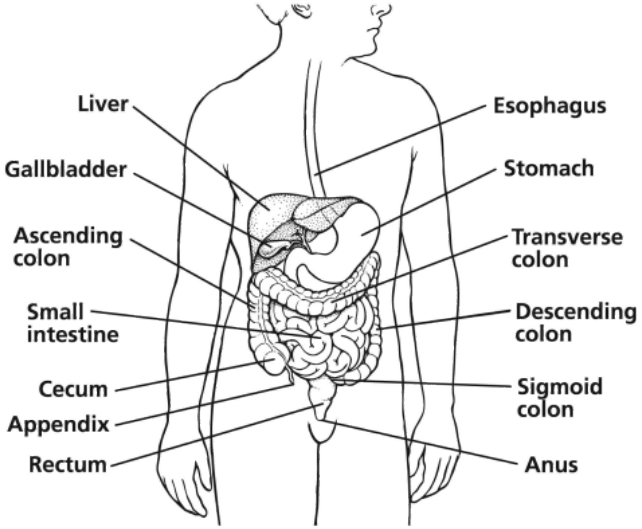
- ROM/Strength
  - UE exercises following any surgical ROM restrictions
  - Serratus anterior weakness
    - Supine rhythmic stabilization at various points of ROM
    - Compare to other side
    - Supine UE elevation punches with 90 degree flexion
  - Tight pecs, elongated and weak middle/lower traps
    - Start supine, stretch over towel/foam roll under thoracic spine
    - Fascial work to release pecs
    - Advance scapular strengthening, prone clocks
  - Rib cage mobility
    - Springing
    - Release intercostals
    - Diaphragm release
    - Deep breathing, focus on areas not expanding

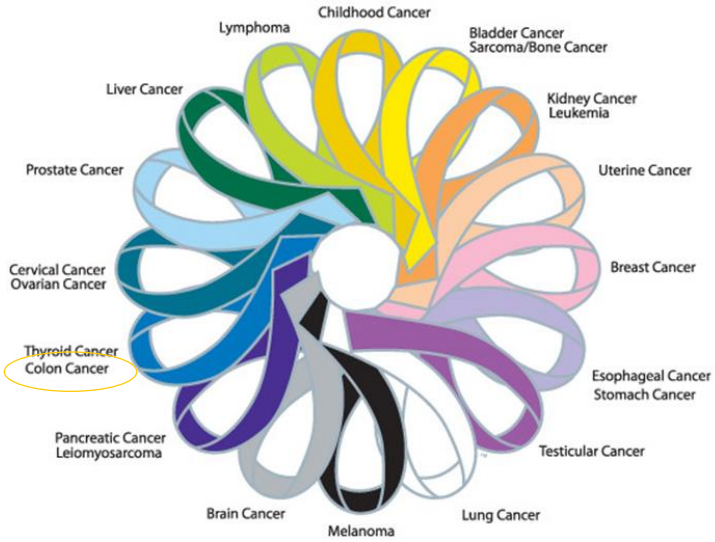
Treatment-Breast Ca

- Neuromuscular Re-education
  - PNF
    - Multidirectional pertubations to UE in supine with UE flexed 90 degrees
    - D1/D2 patterns
    - Scapular downward rotation
  - Sahrmann exercises
  - Taping
  - Ensure patient not compensating
  - Less is more, be precise
  - May need to start supine/gravity eliminated and progress

Sample Goals

- Patient will:
  - increase ROM in ER by 15 degrees to don seatbelt.
  - increase shoulder flexion to 3+/5 to place dishes in overhead cabinet.
  - be independent in management of scar tissue in order to decrease pain to allow for pain-free ADL's.
  - demonstrate improved scapulohumeral rhythm in order to prevent impingement or tendonitis in left shoulder.
  - improve balance to good in dynamic situations for safe community ambulation.
  - perform aerobic exercise safely for 20 min with stable vital signs to allow for community exercise to optimize health.





Colorectal Cancer

Colorectal Cancer

- Most begin as a polyp in the inner lining of the colon or rectum
- Adenocarcinomas make up ~95% of colorectal cancers
- In 2017:
  - 95,520 new cases of colon cancer
  - 39,910 new cases of rectal cancer

Colorectal Cancer Risk Factors

- Overweight or obese
- Physical inactivity
- Diets high in red & processed meats
- Smoking
- Heavy alcohol use
- Older
- History of inflammatory bowel disease
- Family history of colorectal cancer
- Having type 2 diabetes

American Cancer Society®

2018 Colorectal Cancer Screening Guideline
for men and women at average risk

Ages 45 – 75

Get screened. Several types of tests can be used. Talk to your doctor about which option is best for you.

Ages 76 – 85

Talk to your doctor about whether you should continue screening. When deciding, take into account your own preferences, overall health, and past screening history.

Age 85 +

People should no longer get colorectal cancer screening.

TESTING OPTIONS

- **Stool-based tests** look for signs of cancer in a person's stool.
- **Visual exams** such as colonoscopy or CT colonography, look at the inside of the colon and rectum for polyps or cancer.
- No matter which test you choose, the most important thing is to get tested.

Visit **cancer.org/colonguidelines** to learn more.

All positive results on non-colonoscopy screening tests should be followed up with a timely colonoscopy to complete the screening process. Talk to your doctor about screening, and contact your insurance provider about insurance coverage for screening.

©2018, American Cancer Society, Inc. All rights reserved. The American Cancer Society is a qualified 501(c)(3) tax-exempt organization and donations are tax-deductible to the full extent of the law. 0803.90

Screening Guidelines for Early Detection of Colorectal Ca

- Beginning at age 50, men and women should follow one of the following examination schedules:
  - A fecal occult blood test (FOBT) every year
  - A flexible sigmoidoscopy (FSIG) every five years
  - A double-contrast barium enema every five years
  - A colonoscopy every ten years
  - *Combined testing is preferred over either annual FOBT or FSIG every 5 years alone.

People who are at moderate or high risk for colorectal cancer should talk with a doctor about a different testing schedule

Colorectal Screening Rates Low:
Reasons (according to Patients)

- Low awareness of CRC as a personal health threat
- Lack of knowledge of screening benefits
- Fear, embarrassment, discomfort
- Time
- Cost
- Access
- *“My doctor never talked to me about it!”*

Statistics

- Lifetime risk
  - 1:21 for men (4.7%)
  - 1:23 for women (4.4%)
  - ~30% of patients are diagnosed with metastatic disease at initial presentation
  - Additional 25% - 30% of patients will subsequently develop metastatic disease

Surgical management - CRC

- Laparoscopic Proctosigmoidectomy
  - Diseased section of the rectum and sigmoid
- Subtotal Colectomy
  - Resection of part of colon
- Abdominoperineal resection (APR)
  - Remove rectum and en bloc resection of levator muscles with gluteal maximus flap
  - No sitting x 6 weeks (or per plastic surgeon)

Chemotherapy - CRC

- 5-Fluorouracil (5-FU)
  - which is often given with the vitamin-like drug leucovorin (also called folinic acid) or a similar drug called levo-leucovorin, which helps it work better.
- Capecitabine (Xeloda)
  - which is in pill form; once in the body, it is changed to 5-FU when it gets to the tumor site
- Irinotecan (Camptosar)
- Oxaliplatin (Eloxatin)--NEUROPATHY
- Trifluridine and tipiracil (Lonsurf)
  - a combination drug in pill form

Radiation Therapy - CRC

- EBRT
- Brachytherapy
  - Radiation reaches the rectum w/o passing through the skin and other tissues of the abdomen
- Endocavitary radiation therapy:
  - Small device is placed through the anus and into the rectum for a few min-high intensity
  - ~4 treatments (or less) w/ 2 weeks between each treatment
  - Allows avoid major surgery and a colostomy
- Interstitial brachytherapy:
  - Tube is placed into the rectum and directly into the cancer
  - Small pellets of radioactive material are then put into the tube for several minutes
  - Radiation travels only a short distance, limiting the effects on surrounding healthy tissues
  - Treat people who are not healthy enough for surgery

EDGE-Colorectal Ca

- Reviewed assessment tools for strength and muscular endurance
- Recommend hand held dynamometry and grip strength
  - Establish baseline and monitor for change
- Unable to recommend MMT, isometric testing

Results of a Strength and Balance Training Pilot Study for Colorectal Cancer Survivors with Peripheral Neuropathy Caused by Oxaliplatin

Cindy Tofthagen, PhD, AVRP, AVCNP, FAANP[1]; Constance Visovsky, PhD, RN, ACNP-BC[2]; Jason Beckstead, PhD[3]; Ian Loy, RN, BSN[4]; Ellen Eckelman, DPT[5]

- Small pilot feasibility and tolerance: only 3 completed study
- Hx CRC, completed oxiliplatin 6 mos prior, + PN sx's
- 12 week bi-weekly 35-50 min strength and balance training
- Feasible and participants report exercise tolerable
- Conclusions:
  - Improved LE strength
  - Improved balance
  - Improved objective PN signs
  - *with improvements in all areas noted by week 4
- More studies needed; alternate delivery methods due to lack of enrollment

Rehab Considerations-Colorectal CA

- Avoid intra-abdominal pressure
  - No abdominal exercises/heavy lifting x 6 weeks
- Osteotomy may be present
- Fatigue
- Incontinence
- Neuropathy

Prostate Cancer

Prostate Cancer

- Cells in the prostate gland grow uncontrollably
- Most are adenocarcinomas
- In 2017:
  - 161,360 new cases
  - 26,730 deaths
- 1 in 7 men will be diagnosed during their lifetime

Prostate Cancer Risk Factors

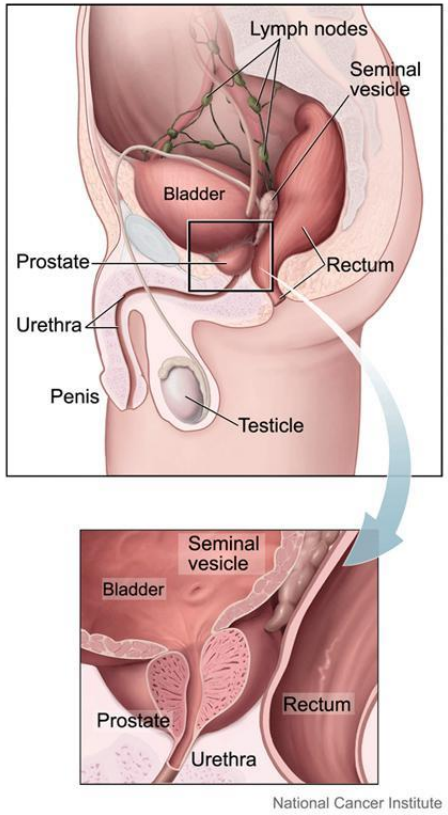
- Age
- Race/ethnicity
  - African-American men & Caribbean men of African ancestry
- Geography
  - More common in North America, NW Europe, Australia & Caribbean Islands
- Family history
  - If brother or father, doubles risk
- Gene changes
  - Lynch syndrome

Screening Guidelines for Early Detection of Prostate Ca

- The prostate-specific antigen (PSA) test and the digital rectal examination (DRE) annually, beginning at age 50
- Men at high risk should begin testing at age 45
  - African-American men
  - A strong family history of one or more first-degree relatives diagnosed with prostate cancer

Prostate Gland

- Size of a walnut
- Sits below bladder & in front of rectum
- Surrounds part of urethra
- Produces seminal fluid for sperm
- Assists with muscular force for ejaculation



Prostate-Specific Antigen

- Prostate-specific antigen (PSA) test
- Digital rectal examination (DRE) annually, beginning at age 50
- Biomarker glycoprotein enzyme encoded by the *KLK3* gene; produced by the cells of the prostate gland
  - Low: 0 to 2.5 ng/mL
  - Slightly elevated: 2.6 to 10 ng/mL
  - Moderately elevated: 10 to 19.9 ng/mL
  - Significant elevated: 20 ng/mL or more
- There is no specific normal or abnormal PSA level
- Higher PSA levels indicate cancer may be present

Prostate-Specific Antigen

- Many conditions may elevate PSA
  - Prostate cancer
  - Benign prostatic hypertrophy (BPH)
  - Prostatitis (inflammation)
  - Infection
  - Age
  - Race
- Combine biomarker levels with:
  - Digital Rectal exam
  - Biopsy

Prostate Cancer Symptoms

- Urinary frequency
  - Nocturia
- Bladder infections
- Blood in urine
- Decreased force of urine stream
- Bone pain
- Back, hip, spine, rib pain
- Weakness or numbness in legs or feet

Surgical Management - Prostate Ca

- Nerve-sparing techniques
- Laparoscopic procedures
- Robotically-assisted procedures
- Retropubic prostatectomy
- Perineal prostatectomy
- Radical prostatectomy/androgen ablation

Surgical Management - Prostate Ca

- Radical Prostatectomy
  - Treatment of choice for localized disease
  - Retropubic & perineal approaches
- Positioning
  - Lithotomy Position, 90 degrees hip flexion

Radiation Therapy-Prostate Ca

- Seed implantation
  - 15-25 fine hollow needles which are pushed through the skin of the perineum
  - May be ultrasound guided
  - 60-120 seeds are placed
  - The seeds stay in the prostate, slowly giving out radiation until they are no longer radioactive

Hormone Therapy-Prostate Ca

- Hormone therapy=androgen deprivation therapy (ADT)
  - Surgical castration (orchiectomy)
  - Medical castration
    - Luteinizing hormone–releasing hormone (LHRH) analogues or antagonists
    - Antiandrogens/other androgen suppressants

Prostate Cancer Sequela

- Incontinence
  - More common if >70 years old
  - 2.5% of all patients incontinent at 1 year
    - Urethral stricture
    - Detrusor instability
- Impotence
  - Nerve sparing procedures will enable 54% of patients to have intercourse without assist
- Lymphedema
- Bowel problems
- Fatigue
- Osteoporosis
- Arthralgias

EDGE-Prostate QOL

- Recommended
  - EORTC QLQ-P25 (European Organization for Research and Treatment of Cancer Quality of Life Questionnaire-Prostate 25)
  - EORTC QLQ-C30 (EORTC Quality of Life Questionnaire-Cancer 30)
  - EPIC (Expanded Prostate Cancer Index Composite)
  - **FACT-P (Functional Assessment of Cancer Therapy-Prostate)**
  - FACT-G (Functional Assessment of Cancer Therapy-General)
  - UCLA-PCI (UCLA-Prostate Cancer Index)
  - SF (Short-Form) 36, 12, and 8

Oncology Section EDGE Task Force on Prostate Cancer: A Systematic Review of Outcome Measures for Health-Related Quality of Life. Harrington S, Lee J, Colon G, Alappattu M. *Rehabil Oncol*. 2016 Jan;34(1):27-35.

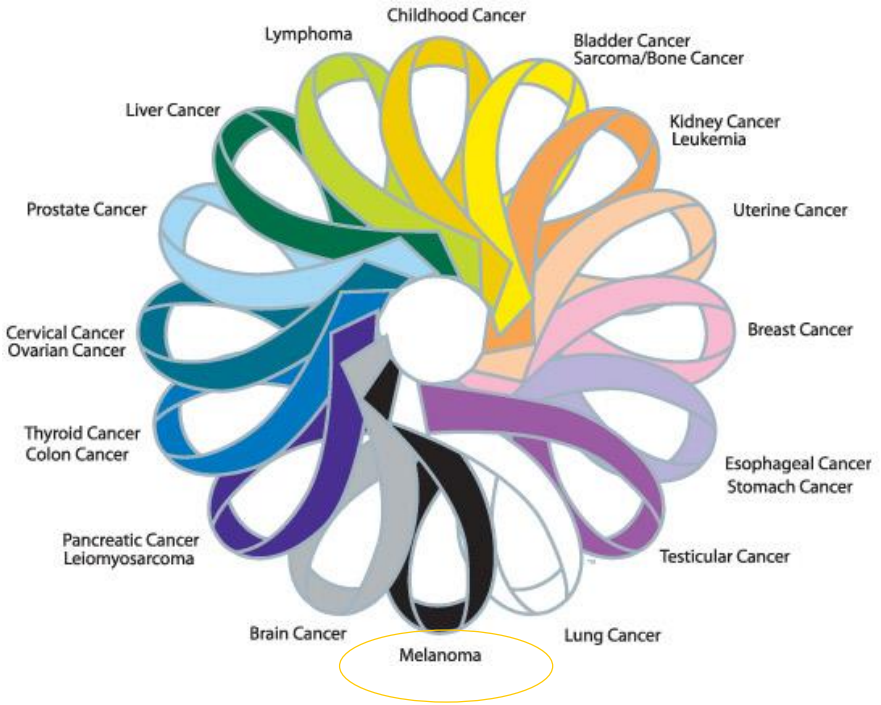
Assessment considerations - Prostate Cancer

- Overall stretching, strengthening and cardiovascular conditioning programs
- Lymphedema risk-reduction education
  - Baseline leg-girth measurements
  - Assessment for cording
- Scar-tissue work
  - Trunk (anywhere restricted), pelvic floor, LE tightness, dural tube stretch
- Pain management
- Pelvic floor management—refer appropriately if you are not trained or experienced in this skill

Treatment Considerations - Prostate Cancer

- Behavioral modification
- Pre-operative Biofeedback
  - Quicker return to continence post-operatively (Burgio K et al. J Urol. 2006)
- Neuromuscular reeducation
  - Uptrain if weak; Downtrain if high resting tone
    - Early post-op
    - Contract-relax techniques (Corneal et al World J Urol. 2005, Filocamo et al Euro Urol. 2005)
- Manual therapy: assess and treat biomechanical alignment
  - L/S, SI, pelvic obliquity, scoliosis

Melanoma


Childhood Cancer
Lymphoma
Bladder Cancer
Sarcoma/Bone Cancer
Liver Cancer
Kidney Cancer
Leukemia
Prostate Cancer
Uterine Cancer
Cervical Cancer
Ovarian Cancer
Breast Cancer
Thyroid Cancer
Colon Cancer
Esophageal Cancer
Stomach Cancer
Pancreatic Cancer
Leiomyosarcoma
Testicular Cancer
Brain Cancer
Lung Cancer
Melanoma

Melanoma

- Cancer that starts in a certain type of skin cell
- Deadliest form of skin cancer (>75% of all skin cancer deaths)
- #1 cancer in young adults aged 25-29

Cancer Epidemiology in Older Adolescents & Young Adults. *SEER AYA Monograph* 2007, pages 53-63.

Melanoma

- Developed from melanocytes not only in the skin, but conjunctiva, GI & genital mucosa & even capsules of lymph nodes
- Deadliest form of skin cancer (>75% of all skin cancer deaths)
- #1 cancer in young adults aged 25-29
- Tumor depth is key determinate of prognosis
- Propensity to metastasize to small bowel & manifest as GI bleeding
  - Brain metastases are common causing seizures

Cancer Epidemiology in Older Adolescents & Young Adults. *SEER AYA Monograph* 2007, pages 53-63.

Melanoma

- In 2016:
  - 76,380 new melanomas diagnosed
    - 46,870 men & 29,510 women
  - 10,130 expected to die
    - 6,750 men & 3,380 women
- Rates have been rising for the last 30 years

Melanoma Risk Factors

- UV exposure
- Moles
- Fair skin, freckling, light hair
- Family history of melanoma
- Weakened immune system
- Older
- Male

Statistics

- The ACS's estimates for melanoma in the US for 2017 are:
  - About 87,110 new melanomas will be diagnosed (about 52,170 in men and 34,940 in women).
  - About 9,730 people are expected to die of melanoma (about 6,380 men and 3,350 women).
  - 1.2 million survivors in the U.S.
  - Rates on the rise over past 30 years

http://www.cancer.org/cancer/melanoma-skin-cancer/about/key-statistics.html

American Cancer Society®

Melanoma Risk Factors

- UV exposure
- Moles
- Fair skin, freckling, light hair
- Family history of melanoma
- Weakened immune system
- Older
- Male

Melanoma Risks

- 20x more common in Caucasians than in African Americans
- Lifetime risk
  - 2.5% (1 in 40) for whites
  - 0.1% (1 in 1,000) for blacks
  - 0.5% (1 in 200) for Hispanics
- Average age of diagnosis is 63 y.o.
- One of the most common cancers in young adults (especially young women)

Melanoma Survival Rates

	5 year survival	10 year survival
Stage IA	97%	95%
Stage IIA	81%	67%
Stage IV	15-20%	10-15%

http://www.cancer.org/cancer/melanoma-skin-cancer/detection-diagnosis-staging/survival-rates-for-melanoma-skin-cancer-by-stage.html

Screening Guidelines for Melanoma

- Patients play an important role in detection (Skin self-examination)
  - ABCDE
- Total body self-examination done by a physician

http://www.skincancer.org/skin-cancer-information/melanoma/melanoma-prevention-guidelines/melanoma-screening-saves-lives

Types of Skin Ca

- Basal Cell Carcinoma
  - Most common skin cancer
  - Typically spread is local, systemic unlikely
- Squamous Cell Carcinomas
  - Firm red nodule
  - May spread to deeper tissues if not treated
- Malignant Melanoma
  - Can arise on skin or existing mole
  - Dark or discolored areas notable for size changes
  - Will spread rapidly to other skin, lymph nodes or organs

Melanoma - Disease Progression

- Spread primarily by lymphatics
- Tends to go anywhere
  - particularly nervous tissue - be alert for new neurologic deficits
- Isolated metastases may be resected
- Systemic therapy minimally effective
  - α-Interferon
  - BCG inoculation
  - vaccines
  - IL-2

Treatments for Melanoma

- Surgery
- Immunotherapy
- Targeted therapy
- Chemotherapy
- Radiation

Melanoma - Treatment Side Effects

- Excessive scar tissue
- Fatigue
- Lymphedema
- Joint pain/immobility

Rehab Interventions-Melanoma

- Endurance exercise program
- Scar tissue mobilization
- Maintain functional mobility
- Pain management
- Joint ROM
- CDT as indicated

Metastases

Cancer Type	Common Metastasis
Breast	Lungs, liver, bones, brain
Prostate	Bones, lungs, liver
Colorectal	Liver, peritoneum, lungs, adrenal gland
Melanoma	Lungs, skin/muscle, liver, brain

Precautions and Red Flags

Precautions for Rehab

Chemotherapy

- Infection control
- Monitor lab values
- Impaired skin integrity
  - Be careful with taping
- Falls
- Nausea/vomiting
- Ototoxicity

Radiation

- Pain
- Fatigue
- Monitor lab values/imaging results
- Infection control
- Weight bearing status
- Skin changes
- CNS Effects
  - Radiation necrosis
  - Encephalopathy
  - Myelopathy

Bone Marrow Suppression

- Myelosuppression / Bone marrow depression
  - Risk factors: chemotherapy, radiation, stem cell transplant/BMT
  - Review CBC if available for the following:
    - Thrombocytopenia
    - Leukopenia
    - Anemia
      - Note: Only guidelines, no standard of care, symptom-based guidelines being developed

Bone Marrow Suppression

	Anemia	Neutropenia	Thrombocytopenia
Normal Values	Males: 14-18 g/dL Females: 12-16 g/dL	5,000-10,000/mL of blood	150-400,000 mm3 (150-400K)
Symptoms	Fatigue, irritability, dizziness, headache, loss of concentration, pallor, tachycardic	Frequent infections, fevers, throat/mouth sores	Bruising, bleeding, petechiae
Complications	Angina, syncope, heart attack	Bacteremia, septic shock	Excessive bleeding, internal bleeding
Treatment	Iron-rich nutrients Transfusion of PRBC's Erythropoietin	Prevent or Control Infections Neutropenic diet	Platelet transfusion
Precautions	Monitor Vitals, Modify intensity	Reverse isolation Neutropenic diet Antibiotics	Avoid increase in blood & intracranial pressure ie) resistance Fall precautions

Red Flags in Cancer Rehabilitation

- Metastatic bone disease
- Brain metastasis
- Pulmonary
- Vascular issues

Red Flags

Metastatic bone disease

- Most common in breast, lung, prostate, colon
- Know location and WBing status
- AROM assessment
  - Functional range of motion only
- Wbing restrictions may be needed for lower extremity mets
- Wbing restrictions may be required for UE as well
  - Need to assess UE strength for use of assistive device

Brain metastasis

- Most common in lung, breast, renal, testicular, melanoma
- Intracranial pressure (ICP)
  - Change in arousal or cognition
    - May be hydrocephalus
  - Maintain head elevation (approx. 30 degrees)
  - Seizures may be present or indicate ICP
- Safety awareness may be impaired
- Cognitive assessment indicated

Red Flags

Vascular

- Some tumors release clotting factors
  - Upwards of 90% of individuals with cancer experience an increase in clotting activity
- Vessel wall injury from chemo or other cancer treatments →coagulation activity
- Risk factors: cancer, surgery, chemo, immobility
- Individuals with cancer are twice as likely to develop DVT's
- Pulmonary Embolism
  - Anticoagulation
  - IVC Filter; not protective for UE DVT's
    - Risk vs. benefit to be considered
- More common in colon, stomach, and ovarian cancers
- Monitor PTT and INR; watch for signs and symptoms

Pulmonary

- Mets to lung most common d/t drainage site
- Signs and symptoms
  - SOB, atypical
  - Unresolved shortness of breath after activity
  - Hemoptysis
  - Persistent dry cough
- Known pulmonary disease
  - Assess vital signs

Oncological Emergencies

- Definition
  - A clinical condition caused by cancer or its treatment resulting from a structural or metabolic change that requires immediate medical intervention to decrease morbidity
  - Not all immediately life-threatening
  - Important to observe and respond to “Red Flags”

Superior Vena Cava Syndrome (SVCS)

- Obstruction of venous drainage and/or increased central venous pressure or as a result of tumor growth or treatment approaches
- Considered emergency situation if:
  - Brain edema; changes in cognition
  - Upper airway edema with possible loss of airway
  - Decreased cardiac output/hemodynamic compromise
- Symptoms
  - Dyspnea
  - Face, neck, arm edema (bilateral)
  - Cough
  - Dysphagia
  - Vocal cord paralysis
  - Horner's syndrome

Superior Vena Cava Syndrome (SVCS)

- Diagnosis
  - Clinical exam
  - Imaging (x-ray, CT scan, MRI)
- Treatment
  - Immediate: sit patient upright; administer oxygen
  - Definitive: Corticosteroids, mediastinal radiation, chemo, stenting, surgery

Spinal Cord Compression

- Increased pressure on the spinal cord with possible collapse of the vertebrae; may be a result of the tumor itself or other non-mechanical factors such as myopathy, myelopathy, virus (herbes zoster), paraneoplastic syndrome, toxicity
- Considered emergency situation if:
  - Sudden onset of weakness and/or incontinence
  - Time dependent on the length of time compressions occurs so immediate referral to ER/imaging is best course of action
- Symptoms
  - Back pain: Increased intensity with Valsalva, weight-bearing, recumbent position
  - Ataxia
  - Weakness
  - Paresthesia
  - Hypotonicity
  - Bladder/Bowel dysfunction
  - Autonomic changes

Spinal Cord Compression

- Diagnosis
  - Imaging: CT scan, MRI
- Treatment
  - Immediate: Corticosteroids
  - Definitive: Radiation, surgery or chemotherapy

Tumor Lysis Syndrome

- A number of metabolic abnormalities caused by the destruction of cancer cells and the release of their intracellular products into the circulation
- Body's homeostatic mechanism cannot process high rate of cell turnover which leads to hyperkalemia, hypocalcemia, hyperphosphatemia, hyperuricemia
- Typically occurs within first several days of beginning chemotherapy
- Symptoms
  - Hyperkalemia: Greatest immediate threat
    - Cardiac arrhythmias
  - Hypocalcemia
    - Muscle cramps
    - Tetany
    - Cardiac arrhythmias
  - Hyperphosphatemia
    - Acute renal failure

Tumor Lysis Syndrome

- Diagnosis: Blood/serum biochemistries
- Patient's at risk
  - Increased WBC count
  - High tumor burden
  - Rapidly dividing tumor
- Treatment: Main goal is prevention!
  - Ideal to give prophylactic regimen 2 days prior to chemo

Hypercalcemia

- Rate of calcium mobilization from bone exceeds kidney's threshold for calcium excretion
- Most common metabolic abnormality found in individuals with cancer
- Occurs with increased bone reabsorption
  - Focal bone destruction
  - Paraneoplastic syndrome

Hypercalcemia

- Symptoms
  - Nausea/vomiting
  - Polyuria
  - Polydipsia
  - Constipation
  - Changes in mental status
  - Kidney stones
  - Acute renal insufficiency
  - Muscle weakness
  - Bone pain

- Diagnosis: Blood/serum biochemistries
- Treatment: IV hydration for mild cases and/or biphosphates to inhibit Ca++ reabsorption from bone
  - If treatment is not timely, individuals my experience:
    - Significantly altered mental status
    - Seizures
    - Coma

Febrile Neutropenia/Septic Shock

- Febrile Neutropenia: Single temperature ≥38.5°C or 3 or more temperatures ≥38°C within 24 hours in setting of low neutropenic count
- Septic Shock: Hemodynamic instability, abnormal coagulation, altered metabolism in response to infection
- May be caused by gram+/- bacteria, fungi, atypical mycobacteria
- Risk Factors
  - Disruption of anatomical barriers
  - Indwelling lines
  - Cross-contamination from medical personnel
  - Decreased defense mechanisms/immune system
  - Chronic antibiotic use

Febrile Neutropenia/Septic Shock

- Symptoms
  - Fever
  - Tachypnea
  - Hypotension
  - Confusion→ severe mental status changes
- Diagnosis
  - Infection screen
    - Blood cultures
    - Urine samples
    - Throat swabs
    - Chest x-ray
- Treatment
  - Antibiotic therapy

Summary

- Rehabilitation Practitioners-Pay Attention!
  - Medically complex population
  - You may be first practitioner to encounter issue and need to flag this
  - Consequence of cancer treatment; may be key source of impairment months to decades later
  - Co-morbidities
  - Psychosocial demands of disease and treatment
- Important to monitor patients and modify PT treatment and goals accordingly
  - Restore function and quality of life to patients with cancer
  - Systematic, comprehensive approach
  - Understand disease process
  - Status along cancer continuum
  - Collaborative approach

Livestrong Report: How Cancer Has Affected Post-treatment Survivors

- Online Survey, 2010
- 2,307 cancer survivors were surveyed about post treatment difficulties in physical, emotional and practical areas:
- 61% were 1-5 years post treatment
- Majority age 20-54 with median age 44
- 86% with at least one impairment

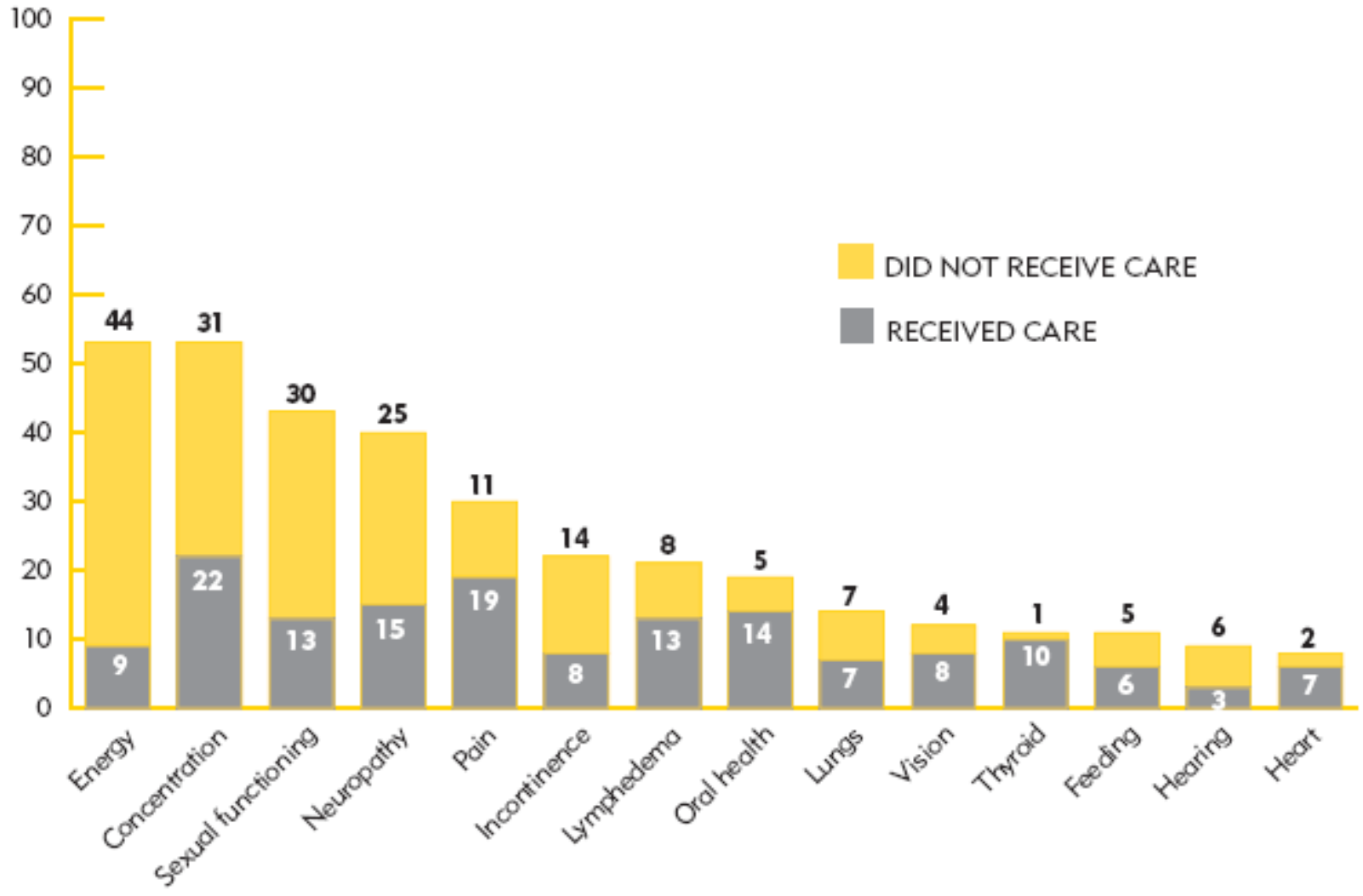
© PORI

Livestrong Report: How Cancer Has Affected Post-treatment Survivors

- Survey Results
  - 91% of cancer survivors experienced at least one physical concern, 75% received help
  - 96% of cancer survivors experienced at least one emotional concern, 55% received help
  - 75% of cancer survivors experienced a practical concern, 40% received help

© PORI

Fig. 17 Receipt of Care: Percentage of Respondents Who Received Care for Physical Concerns, 2010



© PORi

Oncology Evaluation

- History
- Cognitive Status
- Outcome Measures
- Home Status
- ADLs
- Patient/Caregiver Goals
- Objective Measurements
- Transfers
- Ambulation
- Assessment
- Referral to PT/OT/SLP
- Goals

History

- Cancer: active, remission, cured/NED
- Cancer Sites: diagnosis, stage
- Treatments: surgery, radiation, chemotherapy
- Metastatic disease: location, bony involvment
- Any other medications or co-morbidities?

Cognitive Status

- Intact
- Impaired
  - Safety/judgement
  - Memory
  - Attention
  - Concentration

Patient Complaints

- Sleep difficulties
- Weakness
- Falls or balance loss, difficulty walking
- Paresthesia
- Incontinence
- Intimacy concerns

Home Status

- Does patient live alone or have assistance?
- Stairs, bedroom location
- Transportation
- Occupation
- Life roles (caregiver, grandmother, firefighter)

ADLs/IADL's

- Difficulty with or dependent for:
  - Bathing
  - Dressing
  - Cleaning
  - Cooking
  - Shopping
  - Laundry

Objective Measurements

- Observation
  - Posture
- Scar restrictions
- Myofascial restrictions after radiation/surgery/lines and tubes
- Edema
  - Circumferential measurements
- AROM/PROM
  - UE/LE
- MMT
  - UE/LE/scapular strength
- Deep tendon reflexes
- Balance
  - Romberg, tandem, SLS
  - EO/EC
- Sensation
  - Light touch, vibration sense

Transfers

- Sit ↔Stand
- Sit ↔ Supine
- Rolling
- Wheelchair ↔ Mat
- Floor ↔ Stand

Ambulation

- Gait on level surface
- Assistive Device
- Curb Negotiation
- Wheelchair Mobility
- Stair Negotiation

Outcome Measures

- 6 MWT: ≥ 1200 ft
- Gait Speed: 1.2 m/s required to cross street
- 5xSTS: Normal = 12 sec +/- 2
- TUG: > 13 sec = fall risk
- mCTSIB: monitor for LOB or postural sway
- Berg: < 45 = fall risk

Functional Outcome Measures

- FACT – G: higher the score, greater quality of life
- FACIT: higher the score, greater quality of life
- ABC: < 67% = falls risk
- LEFS: higher the score, increased function
- Quick DASH: higher the score, increased disability

Physical Therapy Screening for CIPN

- History: Review cancer treatments
- Interview: Ask about nerve symptoms
  - Numbness/tingling
  - Discomfort: Constriction
  - Pain: Stabbing
- Exam: Assess nerve function
  - Distal joint position sense testing
  - Vibratory threshold

Why Joint Position Sense and Vibration?

- Provides important information concerning cutaneous sensory receptors, peripheral nerves, dorsal roots and central nervous system pathways
- Proprioception: sense of position and movement of limbs in absence of vision
  - 2 components: stationary and kinaesthesia

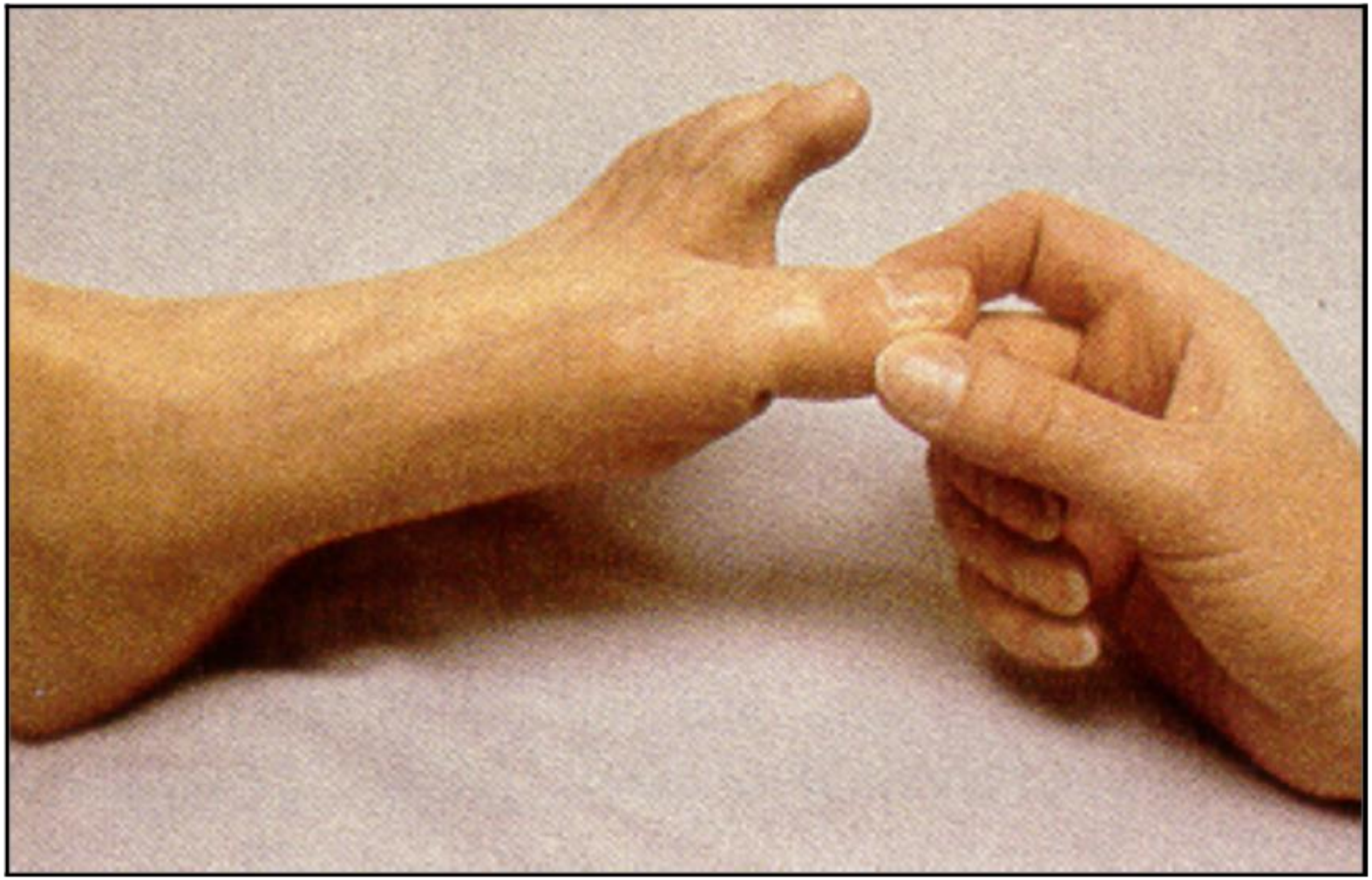
© PORI

Joint Position Sense

- Ask patient to initially look at the great toe while you demonstrate the positions of dorsiflexion and ventral flexion (up and down)
- Grasp the toe on the medial and lateral surface
- Move the joint over 1 to 2 seconds as the sensitivity is inversely related to the velocity of displacement
- Can also test dynamic stimuli if you ask the patient to determine the direction while you move the toe

© PORI

Joint Position Sense



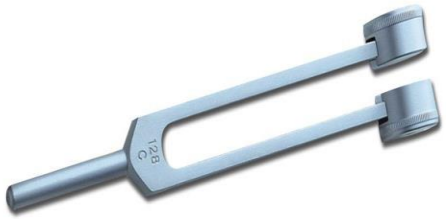
Vibration

- Sense of vibration results from the sinusoidal oscillation of objects placed on the skin
- Mechanoreceptors in the skin respond and develop and action potential that course through peripheral nerves and dorsal roots to enter the spinal cord
- Receptors responsible for vibration are the Merkel disk receptors and Meissner's corpuscles
  - Both are myelinated receptor afferents

© PORi

Tuning Fork

- 128 hz tuning fork most commonly used
- Best to test the patient with their eyes closed
- Apply to skin overlying bone, not fat or muscles
- In patients over the age of 70, vibration may be absent in the great toe but should be preserved at the medial or lateral malleolus
- Documentation
  - Absent?
  - Diminished? (pt. stops feeling it while it is still vibrating)
  - Normal (pt. feels it until it stops vibrating)



© PORI

Biothesiometer

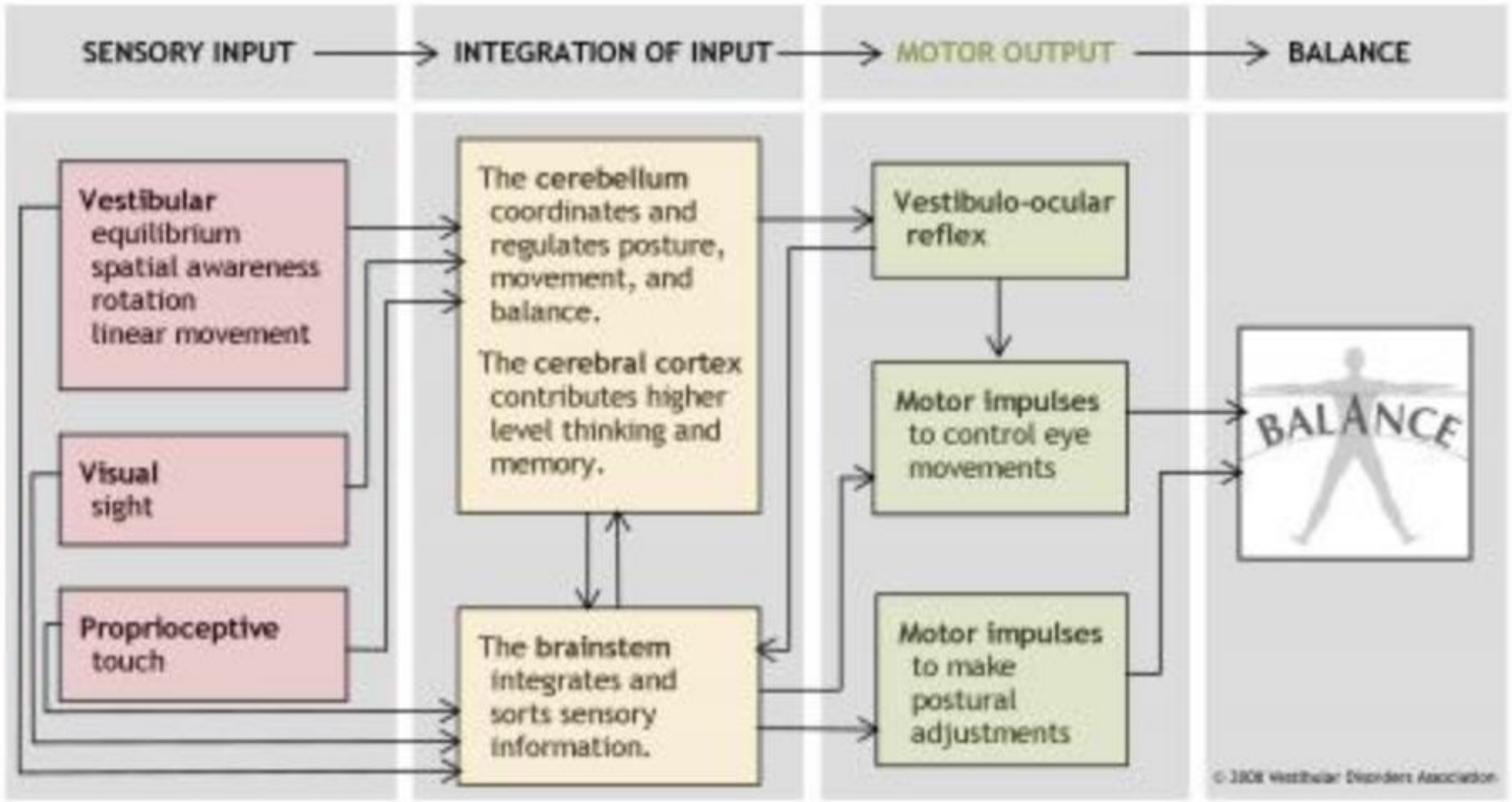
- “electrical tuning fork”
- amplitude may be set to any predetermined level
- amplitude may be gradually increased until the threshold of vibratory sensation is reached

- Mean of Vibration Threshold: Normal Population

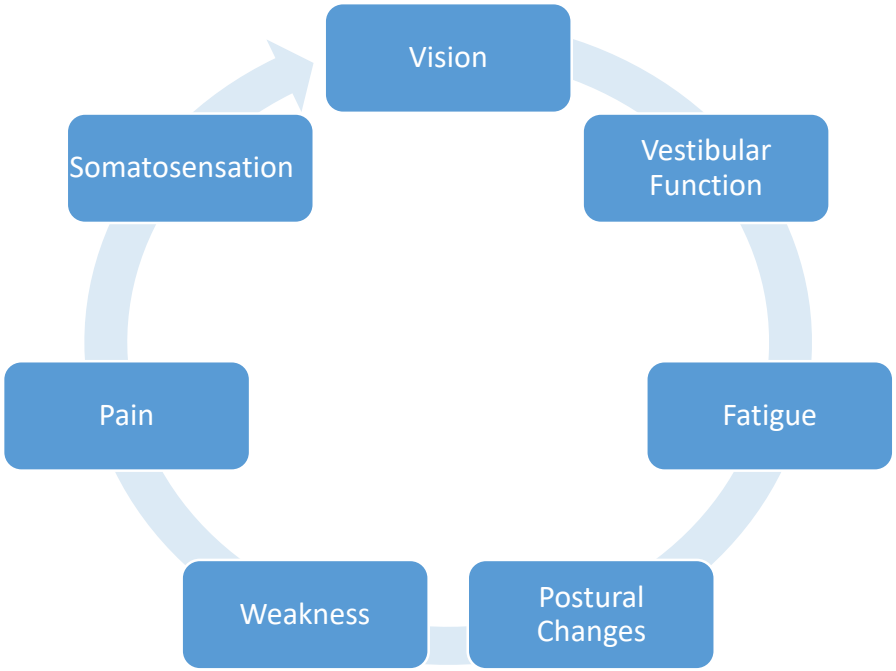
Age	Great Toe	Medial Malleoli
40	9.6	12.2
50	12.1	14.9
60	15.2	18.3
70	19.1	22.5
80	23.9	27.6
90	30.0	33.9

Assess Balance

- Standing Balance
  - CTSIB
  - Single leg stance
    - <5 sec (Vellas 1997)
  - Tandem Stance
    - < 10 sec (Rossiter-Fornoff 1995) or need for assist into position (Hile 2012)
  - With head movements, dual task
  - 5xSTS: > 12 sec (Tiedemann 2008) or loss of balance


SENSORY INPUT
INTEGRATION OF INPUT
MOTOR OUTPUT
BALANCE
Vestibular
equilibrium
spatial awareness
rotation
linear movement
Visual
sight
Proprioceptive
touch
The cerebellum coordinates and regulates posture, movement, and balance.
The cerebral cortex contributes higher level thinking and memory.
The brainstem integrates and sorts sensory information.
Vestibulo-ocular reflex
Motor impulses to control eye movements
Motor impulses to make postural adjustments
BALANCE

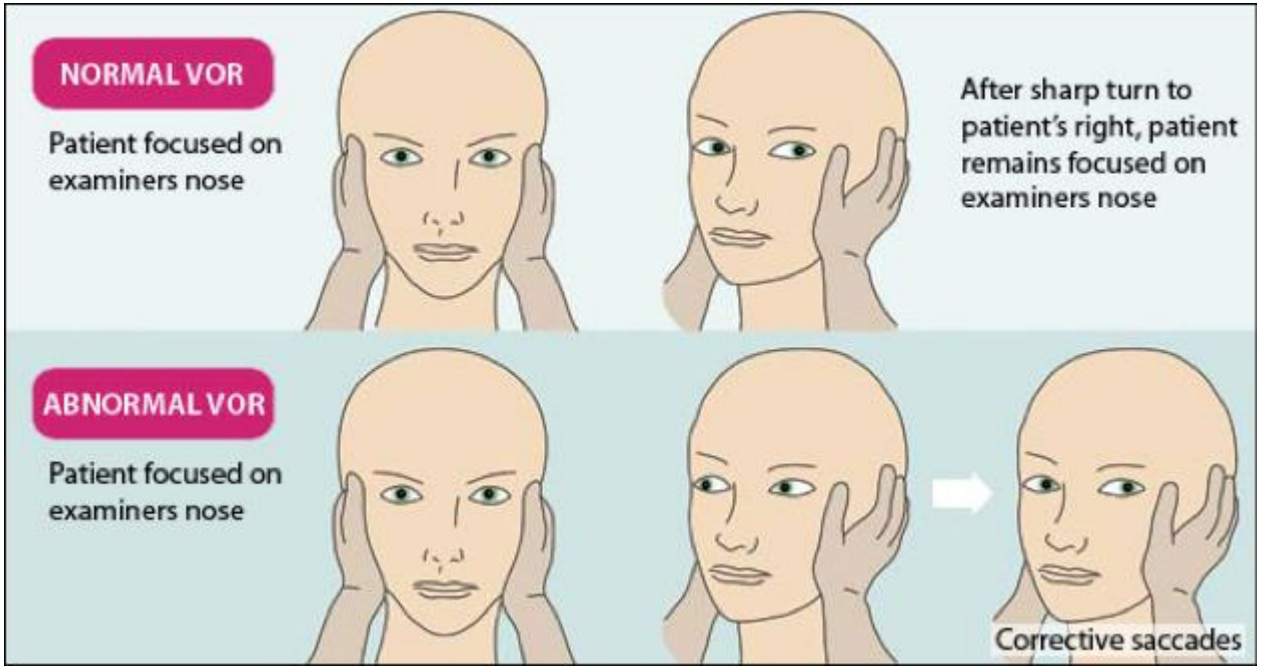
Imbalance is a multifactorial problem



Screening for Vestibular Deficit

- History: Review cancer treatments
- Interview: Ask about vestibular symptoms
  - But what if bilaterally symmetrical decline?
  - Bending, turning, head movements, dark, busy surround
- Exam: Assess vestibular component to imbalance
  - Eye movements, tracking, VOR
  - CTSIB
    - Foam

VOR x 1



http://sjrhem.ca/resident-clinical-pearl-hints-exam-in-acute-vestibular-syndrome/

Assess Gait

- Speed
  - Clinically Meaningful Values
    - 1.2 m/s (Studenski 2011)
    - 1.0 m/s (Cesari 2005)
    - 0.8 m/s (Studenski 2011)
    - 0.6 m/s (Abellan van Kan 2009)
    - Notes: Fast may be easier than slow…
- DGI/FGA
  - Head turns, Turn/stop, eyes closed

Physical Therapy Treatment Examples

- Improve balance reactions
- Improve vestibular responses, allow for habituation for dizziness
- If BPPV present, canalith repositioning maneuver performed
- Improve gait kinematics and quality
- Improve lower extremity strength and ROM
- Improve overall endurance and activity tolerance
- Decrease risk of falls

Patient Statements

- “I sway when I stand still.”
- “I need to touch furniture or walls for support.”
- “I trip or lose my balance when moving around my house.”
- “I have difficulty walking in dark environments or in the grass.”
- “I lose my balance when I walk slow or suddenly stop.”
- “I am unsteady or dizzy when I turn or change positions.”

When to Intervene?

- Initial assessment prior to chemo; establish baseline
- PT once weekly; prescribed extensive HEP
- Reassess after 3rd dose of chemo; sooner if neuropathy presents
- Duration of treatment for as long as it is needed

Referral to PT/OT/SLP

- Consider referral to general/ortho:
  - Generalized weakness
  - Generalized fatigue
  - Musculoskeletal Pain

Referral to PT/OT/SLP

- Consider referral to pelvic floor therapist in setting of:
  - Axillary cording
    - soft tissue cords running from axilla down arm/wrist
  - Moderate/severe scarring of the axilla
  - Edema
  - Internal/External abdominopelvic pain
  - Urinary/Fecal incontinence or urgency
  - Pain/Difficulty with bowel movements

Referral to PT/OT/SLP

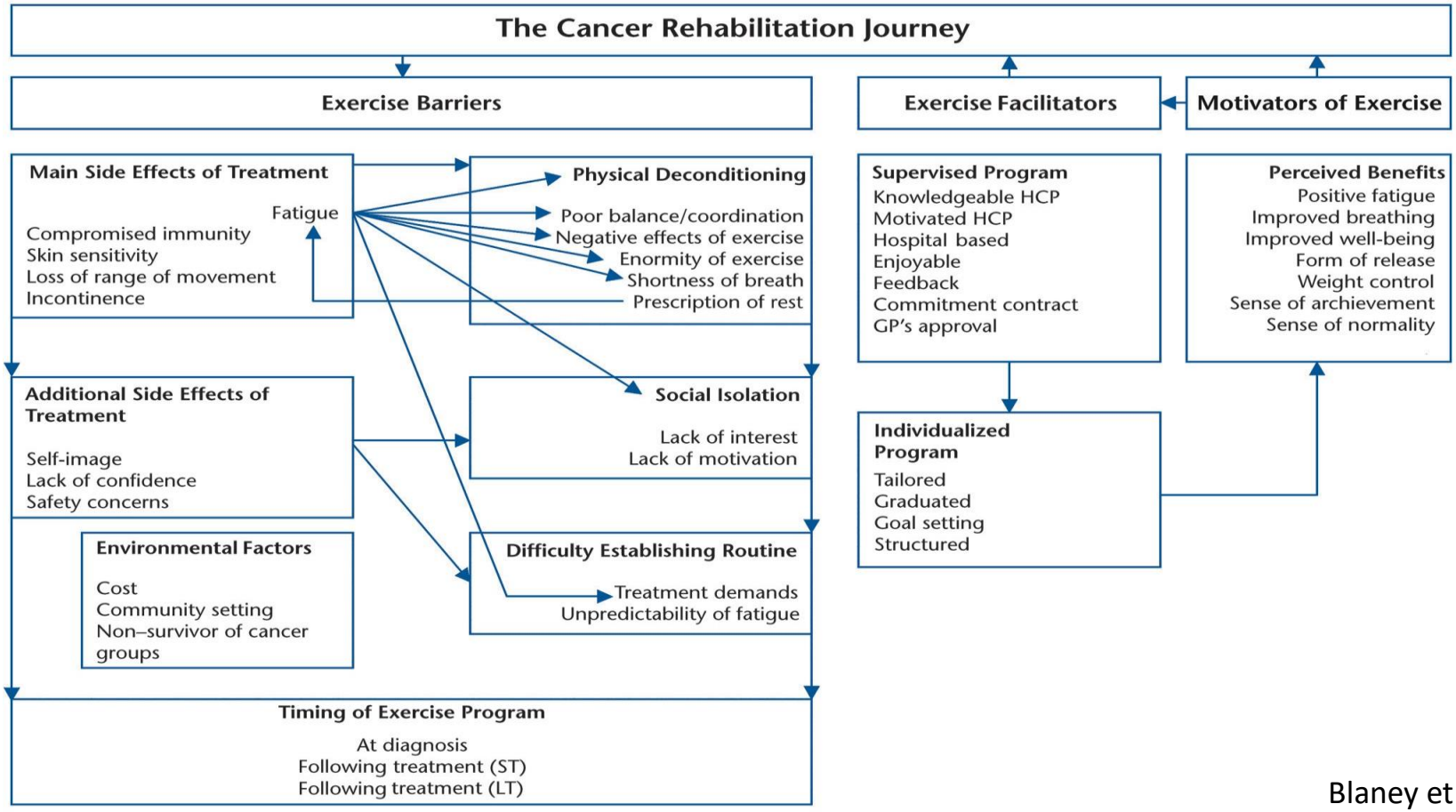
- Consider referral to neuro therapist:
  - Recent falls or near falls
  - Reports or demonstrates of losses of balance
  - ABC scale score < 70%
  - Reports dizziness
  - Tingling/numbness in hands/feet

Referral to PT/OT/SLP

- Consider referral to Occupational Therapy:
  - Pain/Impairments in hand and/or UE function
  - Difficulty with ADLs/IADLs
  - Fine motor coordination impairments
  - Work/leisure considerations

Referral to PT/OT/SLP

- Consider referral to Speech-Language Pathology:
  - Swallowing changes/difficulty
  - Speech/language impairments
  - Reports or demonstrates cognitive impairments
  - Head and neck impairments



Blaney et al, 2012

Why Exercise?

- Cancer treatment and associated bed rest/decrease in physical activity lead to poor physical fitness requiring
  - Greater effort to perform ADLs
  - Increase levels of fatigue when performing ADLs

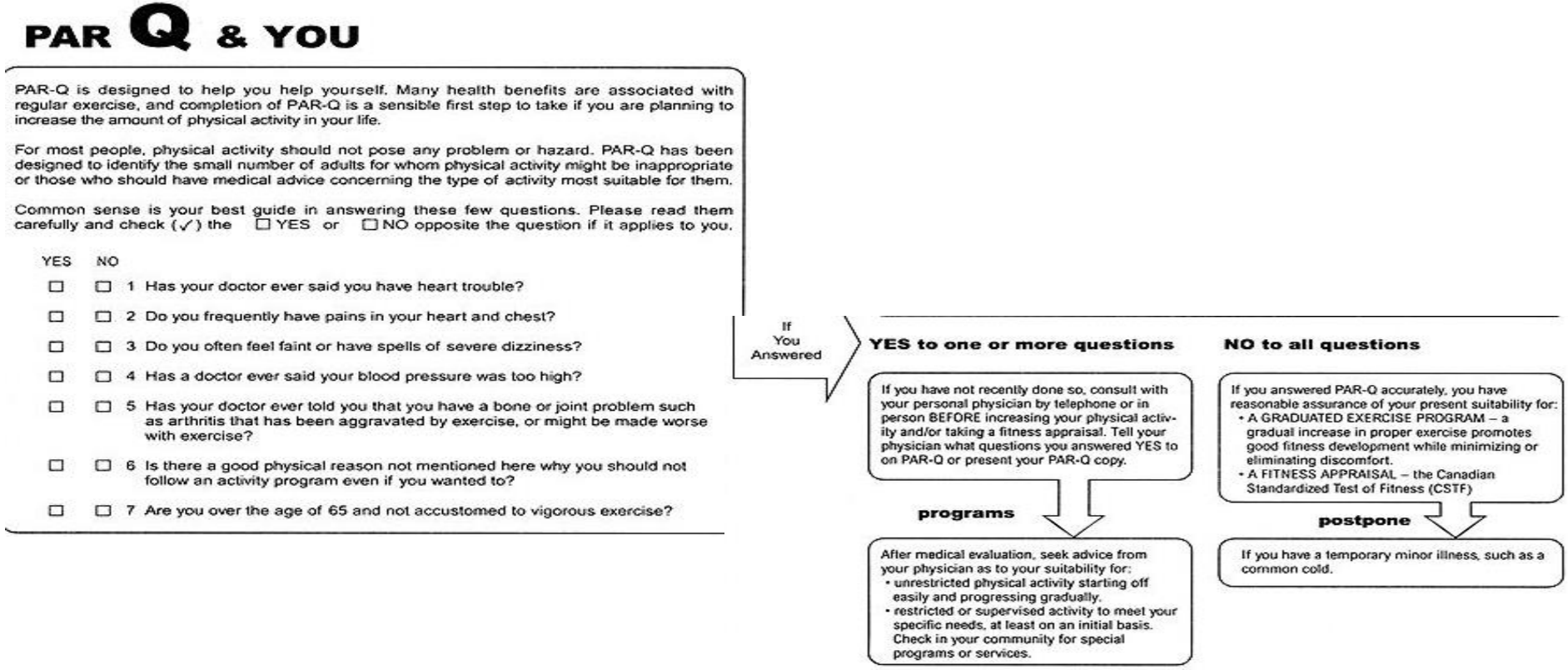
Persoon et al, 2013

- Exercise may reverse this downward spiral
  - ACSM states certain cancer survivor groups benefit from exercise training; it is safe and results in improved physical functioning and reduced fatigue

Why Exercise?

- Recent review by Loprinzi & Lee demonstrate:
  - Cancer survivors are relatively inactive
  - Physical activity may reduce risk of cancer recurrence and cancer related mortality
  - Activity may also reduce pain and improve physical and mental health

Physical Activity Readiness Questionnaire (PAR-Q)



PAR Q & YOU

PAR-Q is designed to help you help yourself. Many health benefits are associated with regular exercise, and completion of PAR-Q is a sensible first step to take if you are planning to increase the amount of physical activity in your life.

For most people, physical activity should not pose any problem or hazard. PAR-Q has been designed to identify the small number of adults for whom physical activity might be inappropriate or those who should have medical advice concerning the type of activity most suitable for them.

Common sense is your best guide in answering these few questions. Please read them carefully and check (✓) the ☐ YES or ☐ NO opposite the question if it applies to you.

YES	NO		
☐	☐	1	Has your doctor ever said you have heart trouble?
☐	☐	2	Do you frequently have pains in your heart and chest?
☐	☐	3	Do you often feel faint or have spells of severe dizziness?
☐	☐	4	Has a doctor ever said your blood pressure was too high?
☐	☐	5	Has your doctor ever told you that you have a bone or joint problem such as arthritis that has been aggravated by exercise, or might be made worse with exercise?
☐	☐	6	Is there a good physical reason not mentioned here why you should not follow an activity program even if you wanted to?
☐	☐	7	Are you over the age of 65 and not accustomed to vigorous exercise?

If You Answered

YES to one or more questions

If you have not recently done so, consult with your personal physician by telephone or in person BEFORE increasing your physical activity and/or taking a fitness appraisal. Tell your physician what questions you answered YES to on PAR-Q or present your PAR-Q copy.

programs

After medical evaluation, seek advice from your physician as to your suitability for:
- unrestricted physical activity starting off easily and progressing gradually.
- restricted or supervised activity to meet your specific needs, at least on an initial basis. Check in your community for special programs or services.

NO to all questions

If you answered PAR-Q accurately, you have reasonable assurance of your present suitability for:
- A GRADUATED EXERCISE PROGRAM – a gradual increase in proper exercise promotes good fitness development while minimizing or eliminating discomfort.
- A FITNESS APPRAISAL – the Canadian Standardized Test of Fitness (CSTF)

postpone

If you have a temporary minor illness, such as a common cold.

Chisholm, 1978

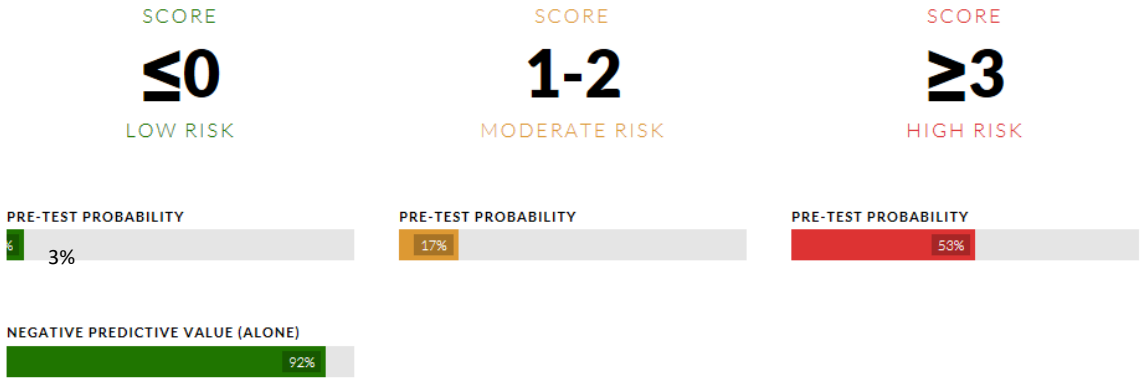
Wells Clinical Prediction Rule for DVT

Clinical Features	Points
Active Cancer (treatment ongoing or within 6 months)	1
Paralysis, paresis, recent immobilization of lower extremities	1
Recently bedridden for ≥ 3 days or major surgery within the previous 12 weeks requiring anesthesia	1
Localized tenderness along deep venous system	1
Entire leg swollen	1
Calf swelling > 3 cm larger than asymptomatic side (measured 10 cm below tibial tubercle)	2
Pitting edema confined in symptomatic leg	1
Collateral superficial veins (not varicose)	1
Previously documented DVT	1
Alternative diagnosis as likely or more likely than DVT	-2

© PORI

Wells Clinical Prediction Rule for DVT

- DVT Risk Stratification

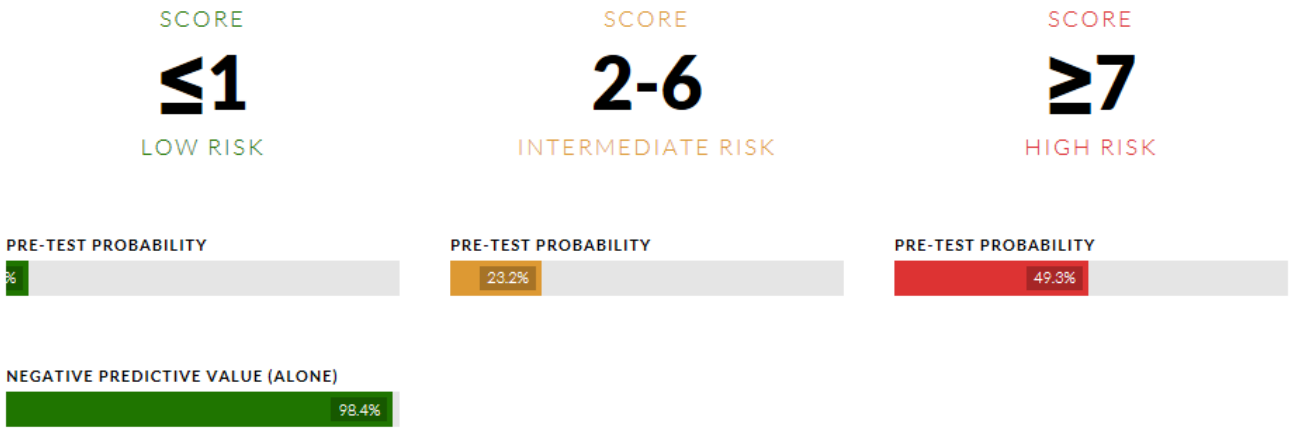


Wells Clinical Prediction Rule for PE

Clinical Variable	Score
Clinical Signs of DVT	3
PE as more likely than an alternative diagnosis	3
Heart Rate > 100 bpm	1.5
Immobilization for ≥ 3 days or surgery in last 4 weeks	1.5
Previous diagnosis of PE or DVT	1.5
Hemoptysis	1
Cancer (currently receiving treatment, treatment stopped within the past 6 months or receiving palliative care)	1

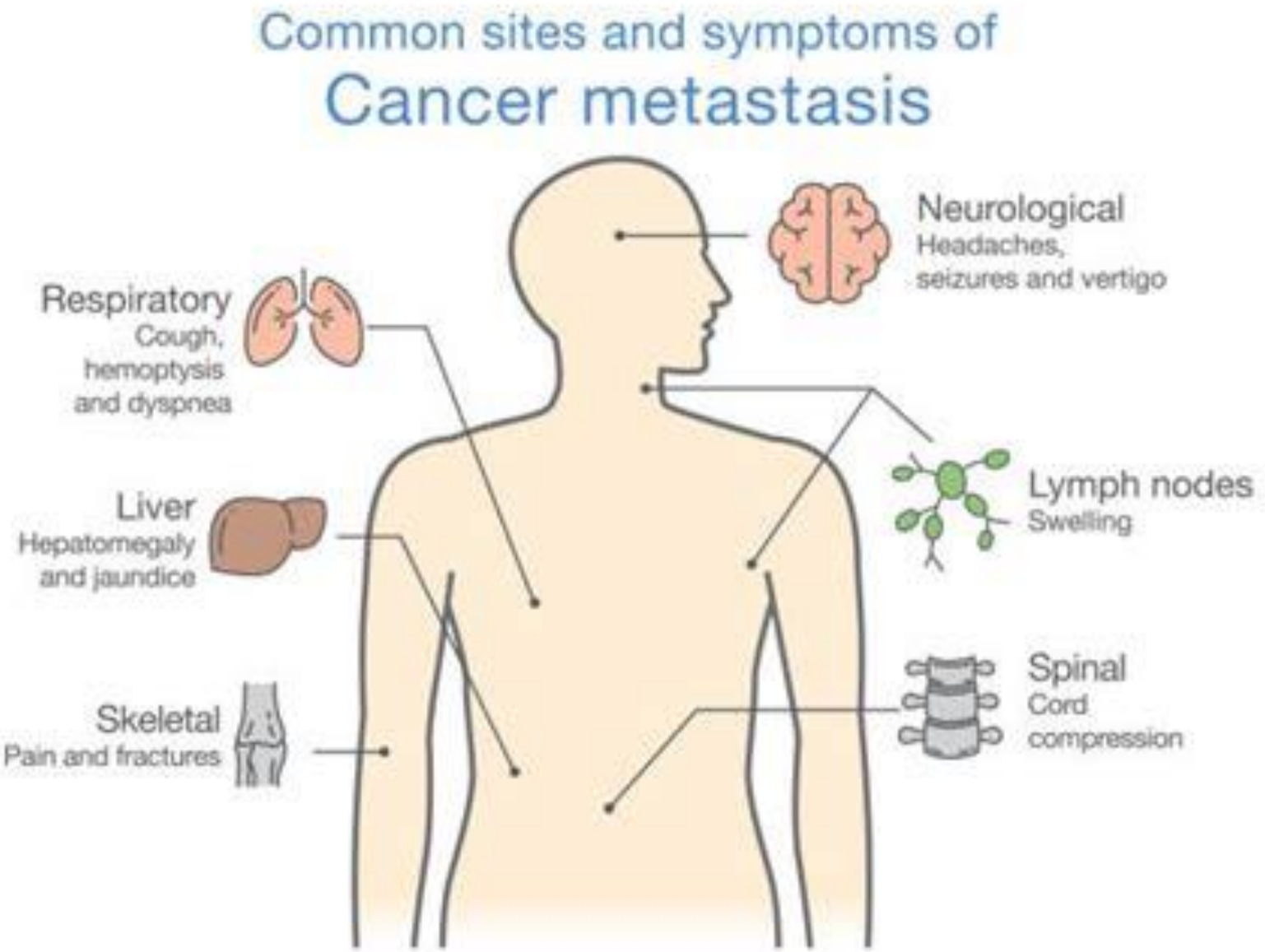
© PORI

Wells Clinical Prediction Rule for PE



© PORI

Cancer type	Main sites of metastasis*
Bladder	Bone, liver, lung
Breast	Bone, brain, liver, lung
Colorectal	Liver, lung, peritoneum
Kidney	Adrenal gland, bone, brain, liver, lung
Lung	Adrenal gland, bone, brain, liver, other lung
Melanoma	Bone, brain, liver, lung, skin/muscle
Ovary	Liver, lung, peritoneum
Pancreas	Liver, lung, peritoneum
Prostate	Adrenal gland, bone, liver, lung
Stomach	Liver, lung, peritoneum
Thyroid	Bone, liver, lung
Uterus	Bone, liver, lung, peritoneum, vagina


Common sites and symptoms of
Cancer metastasis
Neurological
Headaches,
seizures and vertigo
Respiratory
Cough,
hemoptysis
and dyspnea
Liver
Hepatomegaly
and jaundice
Lymph nodes
Swelling
Spinal
Cord
compression
Skeletal
Pain and fractures

Weight Bearing Status

- Want to measure the amount of cortical invasion
- 25% to 50% to 75%

Fracture Risk & Prophylactic Surgery

- Mirel's: Scoring system quantifying the risk of pathological fracture and urgency for orthopedic surgical intervention
- Gives numerical value for their metastatic lesion depending on
  - the size of the lesion
  - the type of lesion
  - the location and biomechanics of the bone involved
  - Patients pain perception

Molloy AP, O'Toole GC. World J Orthop. 2013

Mirel's Classification for Pathological Fracture Risk

	1	2	3
Location	Upper Extremity	Lower Extremity	Intertrochanteric
Radiographic Appearance	Blastic	Mixed	Lytic
Size Fraction of Cortical Thickness	< 1/3 (~25%)	1/3 – 2/3 (~50%)	>2/3 (>50%)
Pain	Mild	Moderate	Aggravated by Function

Mirel's Scoring System

Score	Fracture Risk	Recommendation
> or = 9	33% - 100%	Prophylactic Fixation is Recommended
= 8	15%	Clinical Judgment
< or =7	< 4%	Observation and/or Radiation Therapy

Is Exercise Safe for Oncology Patients?

- Resistance Training Study:
  - Breast Cancer survivors
    - N = 85
  - 6 months of resistance exercise training
  - 7 reports of injuries
    - Back – 4; 1 each – shin, wrist, other
    - 1,100 hours of exercise
    - No injuries prevented continuing exercise program

Schmitz et al, 2005

How to Assess Cardiorespiratory Fitness

- Several studies have used the following methods to assess cardiorespiratory fitness prior to beginning an exercise program
- Looks at VO2 Max: best measure of overall heart function
  - Six Minute Walking Test
  - Submaximal cycle ergometry (Persoon et al, 2013)
  - Modified Balke Protocol
  - Modified Bruce Fitness Test (Broderick et al, 2013)
  - University of Northern Colorado Cancer Rehabilitation Institute

Cardiovascular Testing: 6 Minute Walk Test (6MWT)

- Used as a sub-maximal test of aerobic capacity/endurance
- The testing area must be a 30m (100 ft.) segment of straight, unimpeded hallway – need a stopwatch for time and paper to count laps
- A “warm-up” period before the test should not be performed
- Participants should use their usual walking aids during the test (cane, walker, etc.) and be dressed in comfortable clothing and walking shoes
- If systolic BP is > 200mmHg or < 60mmHg, or diastolic blood pressure > 110mmHg discontinue the test
- If resting heart rate is > 120 or < 50 beats per minute discontinue the test

Cardiovascular Testing: 6MWT

- Test Instructions:
  - The object of this test is to walk as far as possible for 6 minutes. You will walk back and forth in this hallway. Six minutes is a long time to walk, so you will be exerting yourself. You will probably get out of breath or become exhausted. You are permitted to slow down, to stop, and to rest as necessary. You may lean against the wall while resting, but resume walking as soon as you are able. You will be walking back and forth around the cones

  - Are you ready to do that? I am going to use this counter to keep track of the number of laps you complete. I will click it each time you turn around at this starting line. Remember that the object is to walk AS FAR AS POSSIBLE for 6 minutes, but don't run or jog. Start now, or whenever you are ready

Cardiovascular Testing: 6MWT

- Standardized Encouragement read in a steady voice:
  - After the 1st minute: “You are doing well. You have 5 minutes to go.”
  - When the timer shows 4 minutes remaining: “Keep up the good work. You have 4 minutes to go.”
  - When the timer shows 3 minutes remaining: “You are doing well. You are halfway done.
  - When the timer shows 2 minutes remaining: “Keep up the good work. You have only 2 minutes left.
  - When the timer shows 1 minute remaining: “You are doing well. You only have 1 minute to go.
  - With 15 seconds to go: “In a moment I’m going to tell you to stop. When I do, just stop right where you are and I will come to you.”
  - At 6 minutes: “Stop”

Cardiovascular Testing: 6MWT

- Limitations: lack of normative data in the oncology population
- Community Dwelling Older Adults Data
  - Steffen et al, 2002; *n* = 96; community dwelling elderly people with independent function who were nonsmokers with no history of dizziness; > 60 y.o. and did not use assistive devices
  - Mean Distance in Meters by Age & Gender

Age	Male	Female
60-69 yrs	572 m	538 m
70-79 yrs	527 m	471 m
80-89 yrs	417 m	392 m

Cardiovascular Testing: 6MWT

- Minimal clinically significant difference (MCSD)
  - MCSD for the 6 MWT must be between 54 & 80 m or 177 ft - 262 ft.

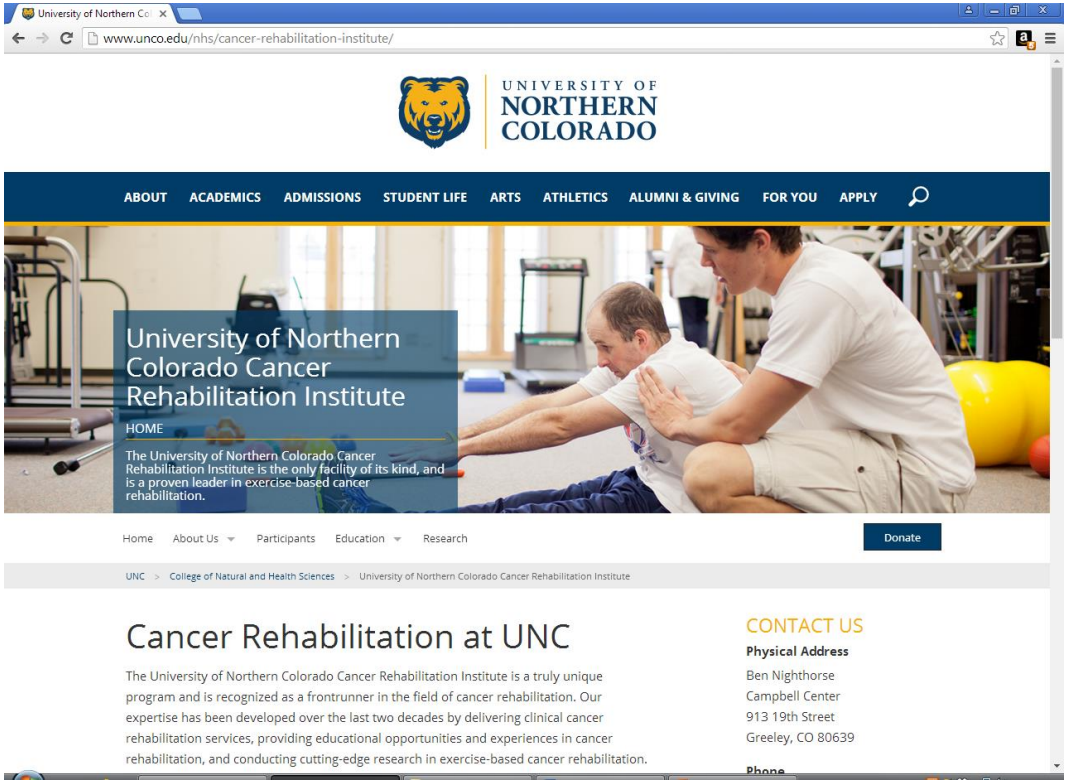
- Wise and Brown

Bruce TM Protocol

Stage	Time	Speed (mph)	% Grade
Warm-Up	2-3 min	1.7	0%
1	3 min	1.7	10%
2	3 min	2.5	12%
3	3 min	3.4	14%
4	3 min	4.2	16%
5	3 min	5.0	18%
6	3 min	5.5	20%
7	3 min	6.0	22%

http://emedicine.medscape.com/article/1827089-technique

University of Northern Colorado Cancer Rehabilitation Institute



• Bruce Treadmill Protocol

Stage	Time	Speed	% Grade
Warm-Up	2-3 Min.	1.7	0%
1	3 min.	1.7	10%
2	3 min.	2.5	12%
3	3 min.	3.4	14%
4	3 min.	4.2	16%
5	3 min.	5.0	18%
6	3 min.	5.5	20%
7	3 min.	6.0	22%

• UNCCRI Protocol

Stage	Speed	Grade	Time
0	1.0mph	0%	1 min
1	1.5mph	0%	1 min
2	2.0mph	0%	1 min
3	2.5mph	0%	1 min
4	2.5mph	2%	1 min
5	3.0mph	2%	1 min
6	3.3mph	3%	1 min
7	3.4mph	4%	1 min
8	3.5mph	5%	1 min
9	3.6mph	6%	1 min
10	3.7mph	7%	1 min
11	3.8mph	8%	1 min
12	3.9mph	9%	1 min
13	4.0mph	10%	1 min
14	4.1mph	11%	1 min
15	4.2mph	12%	1 min
16	4.3mph	13%	1 min
17	4.4mph	14%	1 min
18	4.5mph	15%	1 min
19	4.6mph	16%	1 min
20	4.7mph	17%	1 min
Cool-Down	**	0%	*

Signs and Symptoms of Cardiopulmonary and Metabolic Deficits

- Dyspnea at rest or during exercise/exertion
- Chest pain at rest or during exercise/exertion
- Dizziness or syncope
- Palpitations
- Orthopnea or paroxysmal nocturnal dyspnea
- Cyanosis/JVD; ankle edema
- Fingernail clubbing
- Presence of a cough (duration?)
- Chest wall malformation
- Abnormal breathing pattern/dyspnea with phonation or vocalization
- Breathing pattern
- Posture
- Resting HR, BP, 02 sats
- Glucose and glycosylated Hb

Morris, 2013

Contraindications

Absolute	Relative
Recent significant change in resting ECG	Left main coronary artery stenosis
Unstable angina	Moderate stenotic valvular heart disease
Uncontrolled cardiac dysrhythmia: symptomatic or hemodhynamic compromise	Electrolyte abnormalities: K+ <3.5mmol/liter
Symptomatic aortic stenosis	Severe arterial hypertension (at rest) Systolic BP >200mmHg Diastolic BP >110mmHg
Uncontrolled heart failure	Hypertrophic cardiomyopathy
Acute PE or pulmonary infarction	Tachydysrhythmia or bradydysrhythmia
Acute systemic infection, accompanied by fever, body aches, or swollen lymph	Uncontrolled metabolic disease (DM, thyroid disorders, renal or liver disease)
Acute myocarditis or pericarditis	Ventricular aneurysm
	Chronic infectious disease (AIDS, hepatitis)
	Mental or physical impairments that lead to an inability to exercise

American College of Sports Medicine, 2009

Lab Valves for Safe Exercise: Platelets

Blood Lab Valves	Range	Walking	Biking	Exercise
Platelets	>50,000	No limitations	No limitations	No limitations
	30-50,000	No limitations	No resistance on bike	To tolerance, light resistance
	21-30,000	No limitations	No resistance on bike	To tolerance, no weights
	11-20,000	No limitations	No biking	To tolerance, no resistance
	5-10,000	No limitations*	No biking*	No exercise*
	<5,000	Essential ADLs in room, only as needed	No biking	No exercise

*Monitor for signs of bleeding or bruising

UPMC, 2014

Lab Values for Safe Exercise: H&H

Blood Lab Valves	Range	Walking	Biking	Exercise
Hemoglobin	>12	No limitations	No limitations	No limitations
	8-12	Short distances, essential ADLS	Short intervals, 5-10minutes	To tolerance
	<8	To tolerance*	No biking	AROM, no resistance
Hematocrit	>25%	No limitations	No biking	To tolerance, no resistance
	<25%	To tolerance	No biking	AROM, no resistance

*Watch for symptoms such as dizziness, fatigue, leg cramping, SOB, rapid HR, gait disturbance, tingling/numbness, exercise intolerance

UPMC 2014

Literature Review of Lab Value Guidelines

Author	Platelet Count	Recommendation	Supported by Evidence or Theory
Winningham, ML, MacVicar, MG, Burke, CA (1986)	<50,000 cells/mm^3	dictate caution regarding activity	Theory
Hicks (1990)	< 25,000 cells/mm^3	should not participate in exercise based rehabilitation interventions	Theory(chapter from book)
Courneya et al (2000)	Between >10,000 cells/mm^3 and <50,000 cells/mm^3	Exercise is safe but exercise intensity should be reduced as the platelet count progressively falls below 50,000 cells/mm^3	Evidence
Coleman (1999)	<20,000 cells/mm^3	No exercise	Theory
Drouin and Pfalzer (2001)	5,000 cells/mm^3	Light exercise is safe	Theory
DeVita et al (2008)	>10,000 cells/mm^3	Exercise is safe with decreased intensity as platelets decrease	Theory
Shin (2011)	<10,000 cells/mm^3	Low resistance exercise, gait training and ADL's did not result in any adverse events when platelets transfused same day	Evidence

Exercise and the Oncology Patient

- In the last two decades, it has become clear that exercise plays a vital role in cancer prevention and control
- To best evaluate a cancer survivor's exercise tolerance and prescribe a safe and effective exercise program, it is necessary to understand the specifics of a cancer survivor's diagnosis and treatments received

FITT Principle

FITT Principle:

Frequency, **I**ntensity, **T**ime (duration), **T**ype (mode)

- **Frequency**
  - Number of sessions per week
    - 3x/week of vigorous activity (>20min/day)
    - 5x/week of moderate activity (>30min/day; bout >10min)

Morris, 2013

FITT Principle: Frequency, **Intensity**, Time, Type

- **Intensity**
  - *Increase time before intensity*
  - Prescribing exercise intensity-HR:
    - % of HR Reserve = HRrest + [(HRmax-HRrest)*(THR)]
  - Peak HR method:
    - Target HR = HRmax* %intensity desired
  - **Always** "triangulate" with RPE

Intensity	% VO2 Peak	% HR Max	RPE
Very light	<20	< 35	< 10
Light	20-39	35-54	10-11
Moderate	40-59	55-69	12-13
Hard	60-84	70-89	14-16
Very hard	> 85	> 90	17-19
Maximal	100	100	20

Morris, 2013

FITT Principle: Frequency, Intensity, Time, Type

- **Time**
  - Total amount of time spent exercising or total caloric expenditure
    - Adjust to patient's fitness level
      - Shorter periods, multiple bouts: 3x/10min/session
  - GOAL: 1x30 minutes/session
  - *Increase time before intensity*

- **Type**
  - What is available?
  - What does the patient want to do?
  - What is safe for the patient?
  - Aerobic, strength, and flexibility training

Morris, 2013

General ACSM Guidelines

- Aerobic Activity
  - Overall weekly volume of 150 mins of moderate-intensity or 75 min of vigorous intensity or an equivalent combination
- Strength Training
  - Two to three weekly sessions that include exercises for major muscle groups
- Flexibility
  - Stretch major muscle groups and tendons on days that other exercises are performed

Schmitz et al , 2010

Moderate and Vigorous Activities

MODERATE ACTIVITIES (I CAN TALK WHILE I DO THEM, BUT I CAN'T SING)	VIGOROUS ACTIVITIES (I CAN ONLY SAY A FEW WORDS WITHOUT STOPPING TO CATCH MY BREATH)
• Ballroom and line dancing • Biking on level ground or with few hills • Canoeing • General gardening (raking, trimming shrubs) • Sports where you catch and throw (baseball, softball, volleyball) • Tennis (doubles) • Using your manual wheelchair • Using hand cyclers (also called ergometers) • Walking briskly • Water aerobics	• Aerobic dance • Biking faster than 10 miles per hour • Fast dancing • Heavy gardening (digging, hoeing) • Hiking uphill • Jumping rope • Martial arts (such as karate) • Race walking, jogging, or running • Sports with a lot of running (basketball, hockey, soccer) • Swimming fast or swimming laps • Tennis (singles)

Rock et al, 2012

Modifications to Guidelines

- Metastatic disease: will require modifications to minimize fracture risk; protect bone integrity
- Cardiac conditions: (secondary to cancer or not) may require modifications and greater supervision for safety
  - Consider current medications and type of chemotherapy or location of radiation

Schmitz et al, 2010

Guidelines for Physical Activity Testing and Prescription

- Breast Cancer Survivors
  - Recommend evaluation for arm/shoulder mobility prior to upper body exercise
  - One rep Max has been demonstrated to be safe with and at risk for Lymphedema
  - Aerobic Exercise Training
    - Recommendations are the same as age-appropriate guidelines
    - Be aware of fracture risk
  - Resistance Training
    - Start with a supervised program
    - No upper limit to which survivors can progress
  - Flexibility Training
    - Recommendations are the same as age-appropriate guidelines

Schmitz et al, 2010

Guidelines for Physical Activity Testing and Prescription

- Prostate Cancer Survivors
  - Recommend evaluation of muscle strength and wasting before exercise
  - Aerobic Exercise Training
    - Recommendations are the same as age-appropriate guidelines
    - Be aware of increased risk for fractures
  - Resistance Training
    - Add pelvic floor exercises for those who undergo radical prostatectomy
  - Flexibility Training
    - Recommendations are the same as age-appropriate guidelines

Schmitz et al, 2010

Guidelines for Physical Activity Testing and Prescription

- Colon Cancer Survivors
  - Evaluation for established infection prevention behaviors with an existing ostomy before engaging in exercise training more vigorous than a walking program
  - Aerobic Exercise Training
    - Recommendations are the same as age-appropriate guidelines
    - Physician permission recommended for patient with an ostomy before participation in contact sports
  - Resistance Training
    - For patient with stoma, start with low resistance and progress resistance slowly to avoid herniation of the stoma
  - Flexibility Training
    - Avoid intra-abdominal pressure for patients with ostomies

Schmitz et al , 2010

Guidelines for Physical Activity Testing and Prescription

- Adult Hematopoietic Stem Cell Transplantation (HSCT) Cancer Survivors
  - No specific medical assessments recommended prior to starting an exercise program
  - Take consideration of CURRENT lab values
  - Aerobic Exercise Training
    - Ok to exercise everyday, lighter intensity and lower progression of intensity recommended
    - Avoid overtraining given immune effects of vigorous exercise
  - Resistance Training
    - Might be more important than aerobic exercise in bone marrow transplant patients
  - Flexibility Training
    - Recommendations are the same as age-appropriate guidelines

Schmitz et al, 2010

Guidelines for Physical Activity Testing and Prescription

- Adult Hematologic (No HSCT) Cancer Survivors
  - No specific medical assessments recommended before starting an exercise program
  - Take consideration of CURRENT lab values
  - Aerobic Exercise Training
    - Recommendations are the same as age-appropriate guidelines
  - Resistance Training
    - Recommendations are the same as age-appropriate guidelines
  - Flexibility Training
    - Recommendations are the same as age-appropriate guidelines

Schmitz et al, 2010

Guidelines for Physical Activity Testing and Prescription

- Gynecologic Cancer Survivors
  - Morbidly obese patients may require additional medical assessment for safety prior to exercise
  - Recommend evaluation of lower extremity lymphadema before vigorous aerobic exercise or resistance training
  - Aerobic Exercise Training
    - Recommendations are the same as age-appropriate guidelines
  - Resistance Training
    - Recommendations are the same as age-appropriate guidelines
    - *No data available on the safety of resistance training in women with lower limb lymphadema. Proceed with caution if the patient had lymph node removal and/or radiation*
  - Flexibility Training
    - Recommendations are the same as age-appropriate guidelines

Schmitz et al , 2010

The PEACH Trial

- Evaluated the feasibility and efficacy of an 8 week supervised exercise program
  - Participants were within 2-6 months of chemotherapy completion
- The primary outcome measure was aerobic fitness
- The aerobic component consisted of three stations
  - Treadmill, rowing machine and stationary bicycle
  - Included warm-up and cool-down
- Results
  - Exercises interventions in the early survivorship phase appear safe, feasible and may lead to improvements in quality of life and fatigue

Broderick et al, 2013

Balance and Falls

- Cancer survivors often have multiple risk factors for falls, including decreased lower limb strength, decreased sensation and reflexes because of chemotherapy-induced peripheral neuropathy, and decreased static and dynamic balance control
- Because the changes in balance may be subtle, it is important to measure postural control in a variety of challenging positions to detect deficits
- Another issue in the detection of balance related deficits has been the under appreciation of CIPN by healthcare professionals

Silver et al, 2011

Fall Risk for Older Adults

- A fall occurred at a rate of 33% in older adults with cancer compared to 29% without cancer
  - 862 older adults aged 65 or older with cancer (Michigan Cancer registry)
  - 8617 older adults without cancer
- Those with a history of cancer were more likely to fall than those without cancer (p=0.03)
- No differences in fall rates were determined by cancer type or stage

Spoelstra et al, 2013

Exercise with Lymphedema

- Exercise is shown beneficial in both patients at risk and with lymphedema
  - Avoidance can lead to deconditioning and potentially increase the risk for lymphedema
- Initiated as a supervised program of slowly progressive exercise training incorporating aerobic, resistance, and flexibility
  - No upper limit weight restrictions
  - Rare adverse effects are demonstrated with exercise programs
  - Training can begin during adjunctive chemotherapy

Schmitz, 2010

Resistance Training with UE Lymphedema

- No difference between high (6-10x 75-85% 1-RM) and low-moderate load (15-20x 55-65% 1-RM on LONG-term (3 months) outcomes of swelling and symptom description.
  - Positive benefits of muscle strength, muscle endurance and QOL vs. control group
  - No adverse events were reported (n=62)
    - Individuals were allowed to choose to wear compression sleeve or not
- No difference between high (6-8 max reps) and low (15-20 max reps) on ACUTE (post, 24-hr post, 72-hr post) swelling and symptom description
  - No adverse events were reported (n=17)
    - Individuals were allowed to choose to wear compression sleeve or not

Cormie 2013a, Cormie 2013b

Strategies to Promote Physical Activity

- Social Cognitive Theory (SCT)
  - Association between cognition, behavioral and environmental influences

- Understanding physical activity-related barriers
  - Fear of movement
  - Perceived risk of injury
  - Pain associated with movement

Loprinzi and Lee, 2014

Cancer Pain

medicine
day
pain
burning
feels
Pain
lasts
sharp
gets
treatment
support
working
worse
aches
joints
knees
sleep
better
when
bending
head
night
worried
walking
bothering
dull

Cancer Pain

- One of the most commonly reported impairments
- Prevalence
  - Patients after curative treatment, 33%
  - Under anticancer treatment: 59%
  - Advanced/metastatic/terminal disease, 64%
  - Patients at all disease stages, 53%
- Pooled prevalence >50% in all types
  - Highest in H&N Ca patients at 70%
  - 16% to 73% of women with breast cancer
  - Of patients with pain>1/3 graded as moderate to severe

Prevalence of Pain in Patients With Cancer: A Systematic Review of the Past 40 Years. *Annals of Oncology*. van den Beuk en-van Everdingen MJ, Rijke J, Kessels, A, Schouten H, Kleef M, Patijn J. Ann Oncol. 2007;18(9):1437-1449.

Etiologies of Cancer Pain

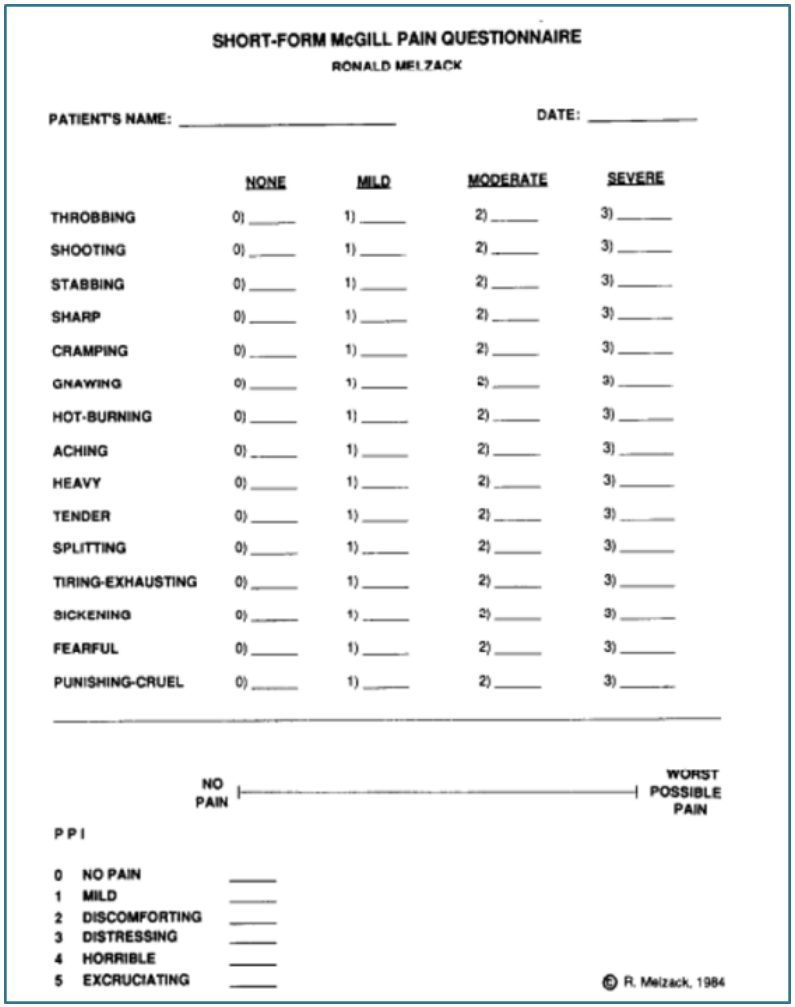
- Direct Tumor Involvement
  - Visceral: Involves organs; “gnawing, crampy, constant, aching, deep”
  - Neuropathic: Results from peripheral or central nerve trauma (causes abnormal firing); “burning, shooting, tingling”
  - Bone: Most common form of cancer pain
  - Cancer Pain Syndrome: Combination of different types of pain, with multiple etiologies, and different treatment methods
- Cancer treatment
  - Chemotherapy
  - Radiation Therapy (RT)
  - Surgery
- Pain unrelated to cancer
  - Pre-treatment or co-existing conditions may be the cause of pain

EDGE – Pain (Recommended Measures)

- Pain intensity/sensitivity
  - VAS, NRS, Pressure Pain Threshold
- Pain Quality
  - McGill Pain Questionnaire, **MPQ-SF**
- Pain-related Disability
  - Pain Disability Index
- Combined Pain Measures
  - Brief Pain Inventory, **BPI-SF**

Sensory

Affective



SHORT-FORM McGILL PAIN QUESTIONNAIRE

RONALD MELZACK

PATIENT'S NAME: _____ DATE: _____

	NONE	MILD	MODERATE	SEVERE
THROBBING	0)	1)	2)	3)
SHOOTING	0)	1)	2)	3)
STABBING	0)	1)	2)	3)
SHARP	0)	1)	2)	3)
CRAMPING	0)	1)	2)	3)
GNAWING	0)	1)	2)	3)
HOT-BURNING	0)	1)	2)	3)
ACHING	0)	1)	2)	3)
HEAVY	0)	1)	2)	3)
TENDER	0)	1)	2)	3)
SPLITTING	0)	1)	2)	3)
TIRING-EXHAUSTING	0)	1)	2)	3)
SICKENING	0)	1)	2)	3)
FEARFUL	0)	1)	2)	3)
PUNISHING-CRUEL	0)	1)	2)	3)

NO PAIN — WORST POSSIBLE PAIN

PPI

0 NO PAIN _____
1 MILD _____
2 DISCOMFORTING _____
3 DISTRESSING _____
4 HORRIBLE _____
5 EXCRUCIATING _____

© R. Melzack, 1984

Brief Pain Inventory (Short Form)

Date: _____/_____/_____ Time: ____

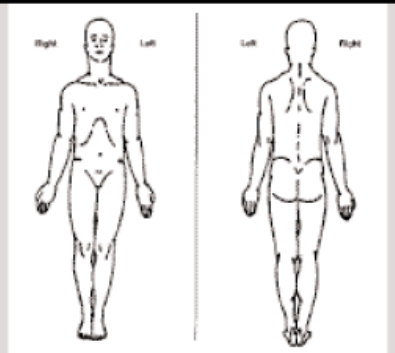
Name: _____ _____ _____

Last First Middle Initial

1. Throughout our lives, most of us have had pain from time to time (such as minor headaches, sprains, and toothaches). Have you had pain other than these every-day kinds of pain today?

   1. Yes 2. No

2. On the diagram, shade in the areas where you feel pain. Put an X on the area that hurts the most.



3. Please rate your pain by circling the one number that best describes your pain at its worst in the last 24 hours.

0	1	2	3	4	5	6	7	8	9	10
No Pain										Pain as bad as you can imagine

4. Please rate your pain by circling the one nuimber that best describes your pain at its least in the last 24 hours.

0	1	2	3	4	5	6	7	8	9	10
No Pain										Pain as bad as you can imagine

5. Please rate your pain by circling the one number that best describes your pain on the average.

0	1	2	3	4	5	6	7	8	9	10
No Pain										Pain as bad as you can imagine

6. Please rate your pain by circling the one number that tells how much pain you have right now.

0	1	2	3	4	5	6	7	8	9	10
No Pain										Pain as bad as you can imagine

Treatment of Cancer Pain

- Medications
  - Non-opioid analgesics (mild pain)
  - Opioid analgesics (severe pain)
- Modalities
  - TENS
  - Heat/cold
- Behavioral interventions
  - Visual imagery
  - Meditation
  - Counseling
- CAM's
  - Herbs
  - Accupuncture

Physical Therapy Implications: Pain

- Considerations
  - Assessment of pain
  - Pre-medicate prior to session
  - Side effects
- PT interventions
  - ROM/Therapeutic exercise
  - Positioning
  - Assistive devices
  - Bracing
  - Modalities

Cancer Related Fatigue (CRF)

CRF

- “a distressing, persistent, subjective sense of tiredness or exhaustion related to cancer or cancer treatment that is not proportional to recent activity and interferes with usual functioning.”

National Comprehensive Cancer Network (NCCN)

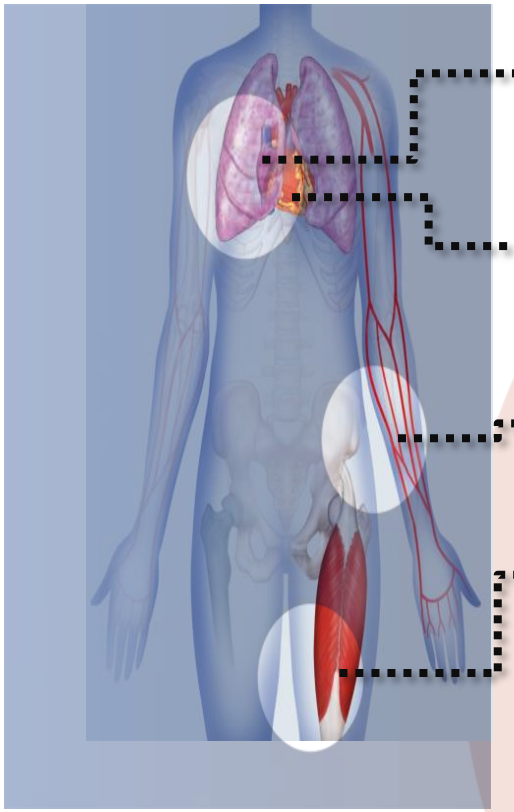
CRF

- Most disabling symptom reported by women diagnosed with breast cancer (Andrykowski et al 2005, Byar et al 2006, Lawrence et al 2004)
- Prevalence in breast cancer 58% to 94% (de Jong et al 2004)
- Subjective, experienced at all stages of cancer
- Often persists many years post treatment (Messke et al 2007, Bower et al 2006)

CRF

- When does this occur?
  - During and after cancer treatment; during normal activities
  - Does not improve with rest
- Incidence
  - Up to 90% cancer patients
- Factors affecting CRF
  - Physical (multi-system dysfunction)
  - Psychosocial (depression, anxiety, sexual dysfunction, finances)

The ‘Multiple Hit’ Hypothesis



Pulmonary function
(systemic therapy, radiation)

+

Cardiac function
(DOX, Herceptin, radiation, SMIs)

+

Vascular compliance (DOX, radiation, SMIs)

+

Skeletal muscle function
(decadron, hormone therapy, chemotherapy?, SMIs?)

=

↓↓↓ CV reserve

Jones et al. *J Am Coll Cardiol*, 2007

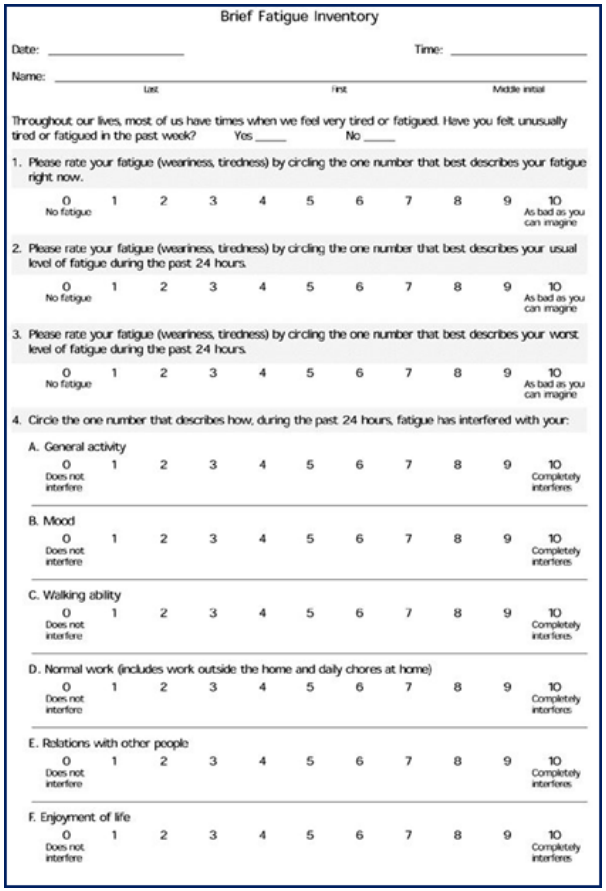
Jones et al. *Lancet Oncol*, 2009

EDGE – Fatigue (Recommended Measures)

- One-Dimensional
  - Brief Fatigue Inventory (BFI)
- Multidimensional
  - Functional Assessment of Cancer Therapy – Breast (FACT-B)
  - Multidimensional Fatigue Symptoms Inventory (MFSI)

Brief Fatigue Inventory

- One dimensional
- Can be used for screening



Brief Fatigue Inventory

Date: _____ Time: _____

Name: _____
Last First Middle initial

Throughout our lives, most of us have times when we feel very tired or fatigued. Have you felt unusually tired or fatigued in the past week? Yes ____ No ____

1. Please rate your fatigue (weariness, tiredness) by circling the one number that best describes your fatigue right now.

0 (No fatigue) 1 2 3 4 5 6 7 8 9 10 (As bad as you can imagine)

2. Please rate your fatigue (weariness, tiredness) by circling the one number that best describes your usual level of fatigue during the past 24 hours.

0 (No fatigue) 1 2 3 4 5 6 7 8 9 10 (As bad as you can imagine)

3. Please rate your fatigue (weariness, tiredness) by circling the one number that best describes your worst level of fatigue during the past 24 hours.

0 (No fatigue) 1 2 3 4 5 6 7 8 9 10 (As bad as you can imagine)

4. Circle the one number that describes how, during the past 24 hours, fatigue has interfered with your:

A. General activity

0 (Does not interfere) 1 2 3 4 5 6 7 8 9 10 (Completely interferes)

B. Mood

0 (Does not interfere) 1 2 3 4 5 6 7 8 9 10 (Completely interferes)

C. Walking ability

0 (Does not interfere) 1 2 3 4 5 6 7 8 9 10 (Completely interferes)

D. Normal work (includes work outside the home and daily chores at home)

0 (Does not interfere) 1 2 3 4 5 6 7 8 9 10 (Completely interferes)

E. Relations with other people

0 (Does not interfere) 1 2 3 4 5 6 7 8 9 10 (Completely interferes)

F. Enjoyment of life

0 (Does not interfere) 1 2 3 4 5 6 7 8 9 10 (Completely interferes)

Multidimensional Fatigue Symptom Inventory Short Form

- 30-item survey
- Subscales: general, physical, emotional, mental and vigor
- Easy to administer and score
- Sound psychometrics

Treatment of Fatigue

Pharmacological

- Phyto-therapeutics
- Corticosteroids
- Hormone therapy
- Anti-depressants

Non-pharmacological

- Cognitive behavioral therapy
- Sleep therapy
- Acupuncture
- *Exercise*

Physical Therapy Implications: Fatigue

- Considerations
  - Help determine possible causes of fatigue
  - Measure vital signs
  - Monitor lab values
- PT interventions
  - Exercise
  - Energy conservation techniques
  - Assistive devices
  - Daily energy log

Evidence for Exercise in CRF

- VanWeert in 2010
  - RCT; 3 groups
    - Treatment group 1: combined aerobic and resistance training
    - Treatment group 2: exercise as above in combination with cognitive behavioral therapy
    - Control: no intervention
  - Outcomes: Fatigue; QOL
- Main purpose of exercise: to reduce fatigue, improve quality of life and physical function
- Findings: Physical training was equally effective as or more effective than physical training combined with cognitive-behavioral therapy in reducing CRF.

Evidence for Exercise in CRF

- Mock in 2005
  - RCT; 2 groups; stratification by type of adjuvant chemotherapy
  - 119 breast cancer patients post-surgery prior to any other adjuvant therapy. Exercising less than 45 min/week
    - Group 1 Exercise: home-based moderate intensity walking program
    - Group 2 Control: no intervention
  - Outcomes: Fatigue; Physical function; 12-min walk
- Main purpose of exercise: to reduce fatigue
- Finding: Moderate-intensity home-based walking exercise was found to be effective in managing fatigue levels during both radiation therapy and chemotherapy.

Evidence for Exercise in CRF

- Segal 2009
  - RCT; 3 groups
  - 121 patients with PCa receiving radiation therapy
    - Treatment 1: Resistance exercise 3 times/week
    - Treatment 2: Aerobic supervised, 3 times/week
    - Control: usual care
  - Outcomes: Fatigue (FACT-F); QOL; aerobic fitness; strength; body composition; blood profile; prostate antigen and testosterone
- Main purpose of exercise: to reduce fatigue, improve cancer-specific quality of life, physical fitness, body compensation, prostate specific antigen, testosterone and serum lipid levels
- Findings: Resistance and aerobic exercise mitigated fatigue in men with PCa receiving radiation.

Research

Current

- Primarily in individuals with solid tumors
- Focuses mostly on aerobic exercise
- Timeframe: during and after cancer therapy

Future

- Broad range of diagnoses
- Participants with advanced disease
- Multi-modal interventions
- Frequency and duration
- Intensity
- Long-term follow-up

Special Considerations in CRF

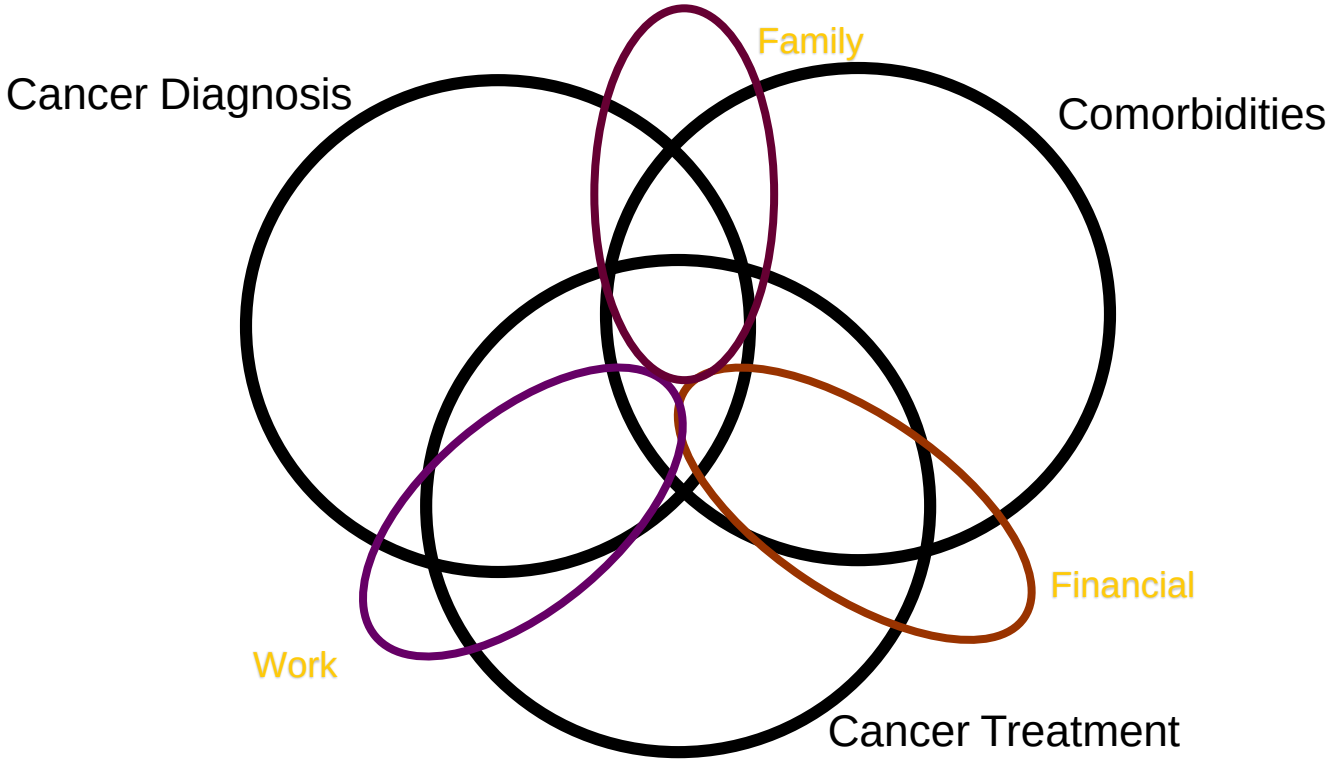
- CIPN
  - Falls
  - Bracing
- Skin checks
- Lymphedema
- Nutrition consult
- Sleep lab referral
- Brain mets
  - Seizures
- Bone mets
  - Weightbearing precautions
  - Avoid high-impact activities
  - Avoid overpressure with ROM

Quality of Life

Quality of Life

- "Individuals' perception of their position in life in the context of the culture and value systems in which they live and relation to their goals, expectations, standards and concerns." (World Health Organization 2012)
- Decreased QOL
  - Related to fatigue (Bower et al 2000)
  - Younger women (Avis et al 2005)
  - Pain (Caffo et al 2003)
  - Upper extremity morbidity (Nesvold et al 2011)
  - Lymphedema (Ridner 2005)

The Patient


Family
Cancer Diagnosis
Comorbidities
Financial
Work
Cancer Treatment

EDGE – QOL (Recommended Measures)

- General QOL
  - Psychological Adjustment to Illness Scale
  - World Health Organization Quality of Life
  - SF-Health Surveys (SF-36, SF-12, SF-8)
- Breast cancer specific QOL
  - EORTC Quality of Life Questionnaire – Breast
  - BREAST – Q
  - **Functional Assessment of Cancer Therapy – Breast (FACT-B)**

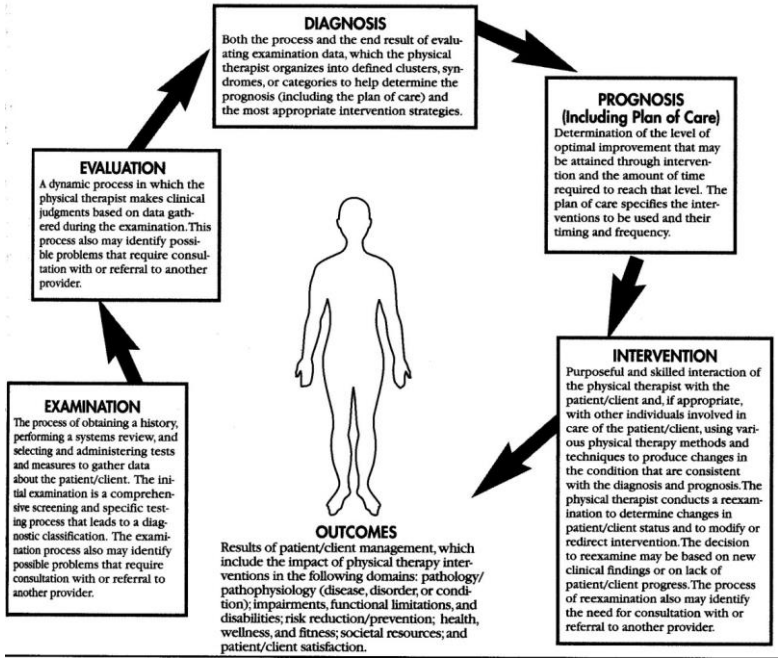
Harrington, et al, 2016

FACT-B (www.facit.org)

- 36-item questionnaire
  - FACT-G plus
    9-item Breast Cancer subscale
- Specific to ***Breast Cancer***
- Good reliability, validity and sensitivity to change
  (Brady et al. 1997)
- MID = 7-8 points (Eton et al. 2004)

Client Management Model

- Examination
- Evaluation
- Diagnosis:
  - Functional Loss
- Prognosis
- Plan of Care
  - Intervention
  - Referrals or Consults
  - Discharge Plan



Other Cancers

Types

- Gynecological
  - Uterine/Cervical
- Hepatobilliary
  - Liver/Gall bladder
- Bone
  - Primary bone very rare/Typically is metastasis
- Sarcoma
  - Many types
- Liquid tumors
  - Leukemia/lymphoma/MM
    - BMT/STC

Impairments

- Pelvic floor dysfunction
  - Muscle tone (hypo/hyper)
  - B&B dysfunction
  - Pain-local or back
- Fatigue
- Scar
- Weightbearing
- Atrophy

Summary Medical History Intake
Cancer Specific

- Identify primary cancer: noting organ or tissues involved
- Stage of disease: how far advanced is the cancer and what tissues are involved
- What point in continuum of care
- Type of surgery: what structures excised, resected
- Radiation: field of beam, overall dosage, side-effects

Summary Medical History Intake
Cancer Specific

- Chemotherapy: Agents used, acute and late effects
- Blood counts: RBC, WBC, hematocrit
- Radiographic information: X-rays, MRI, CT
- Surgical reports?
- Is there evidence of metastasis?
- Prognosis?

Take Aways

- You will see patients with a hx of cancer your clinic
- You may be the first provider to assess a situation requiring further medical attention-pay attention
- During history/intake, ask about the cancer history, treatments, maintenance treatments, future treatments (where are they along continuum of care)

Take Aways

- Gather surgical reports if possible
- Anatomy may not be normal
- Survivors have an accelerated physiological age
- Assess weather or not the cancer/cancer treatment could be the key impairment of the patients problem

Take Aways

- May require modification of a plan or intervention (slower to respond/recover)
- Myofascial work may elicit emotional response; listen to your patients, adjust treatment accordingly
- Assess in gown, view scars, tissue; ask permission for more personal areas and explain why you would assess these areas

Take Aways

- Provide appropriate treatment and modify in response (not overly aggressive, but reach a therapeutic threshold); if unfamiliar then research, ask questions, understand patient goals
- Ask individual's what life was like before cancer treatment, ask them what they did, would they like to return to these activities?

Take Aways

- Ensure include co-morbidities in assessment and explanation of variance in achieving goals
  - eg) Fatigue limits participation, may need more visits to achieve goals
  - eg) Radiated skin may take longer to respond
  - eg) Lymphedema exacerbation possible, gentler approach required

Take Aways

- Use EDGE recommended measures and other evidence-based assessment tools
- Abundant opportunities to research
- Opportunities to implement prospective surveillance models
- Educate referring practitioners on rehab oncology

Take Aways

- You may be first practitioner to provide optimism and/or hope to patients that they can regain their function, energy, and achieve their goals
- Point out gains and accomplishments, encourage through set-backs

References

- American College of Sports Medicine. *ACSM's Guidelines for Exercising Testing and Prescription 8th edu*. Philadelphia: Lippincott Williams & Wilkins; 2009.
- Blaney J, Lowe-Strong A, Rankin J, Campbell A, Allen J & Gracey J. *The Cancer Rehabilitation Journey: Barriers to and Facilitators Among Patients with Cancer-related Fatigue*. Phys Ther 2010 90:1135-1147
- Broderick JM, Guinan E, Kennedy MJ et al Feasibility and efficacy of a supervised exercise intervention in de-conditioned cancer survivors during the early survivorship phase: the PEACH trial. Journal Cancer Survivors. 2013 7: 551-562
- Chisholm DM, Collis ML, Kulak LL, Davenport W, Gruber N, & StewartG. PAR-Q Validation Report: The evaluation of a self-administered pre-exercise screening questionnaire for adults. *BC Ministry of Health and Health and Welfare*.1978.
- Cormie P, Pumpa K, Galvao DA, et al. Is it safe and efficacious for women with lymphedema secondary to breast cancer to lift heavy weights during exercise: a randomized control trial. *J Cancer Surviv*. 2013; 7:413-424.
- Cormie P, Galvao DA, Spry N and Newton RU. Neither heavy nor light load resistance exercise acutely exacerbates lymphedema in breast cancer survivor. *Integr Cancer Ther.* 2013; 12:423-432.
- Loprinzi PD, and Lee H. Rationale for Promoting Physical Activity Among Cancer Survivors: Literature Review and Epidemiologic Examination. *Oncology Nursing Society*. 2014; 41: 117-125
- Morris S. *Fitness testing and exercise prescription.* Presentation at: Rehabiliation Considerations for the Oncology Patient; February, 2013; Pittsburgh, PA.

References

- Rock CL, Doyle C, Demark-Wahnefired W, Meyerhardt J, Courneya K, Schwartz AL et al. *Nutrition and Physical Activity Guidelines for Cancer Survivors* CA Cancer J Clin 2012 62: 242-274
- Schmitz KH, Ahmed RL, Hannan PJ, Yee D. Safety and efficacy of weight training in recent breast cancer survivors to alter body composition, insulin, and insulin-like growth factor axis proteins. Cancer Epidemiol Biomarkers Prev 2005;14:1672-80
- Schmitz KH. Balancing lymphedema risk: exercise versus deconditioning for breast cancer survivors. *Exerc and Sports Sci Reviews.* 2009; 38:17-24.
- Schmitz KH, Courneya KS, Matthews C, Demark-Wahnefried W et al *American College of Sports Medicine Roundtable on Exerciese Guidelines for Cancer Surivors*. Medicine & Science in Sports and Exercise 2010
- Spoelstra SL, Given BA, Schutte DL, Sikorskii A, You M & Given CW. Do older adults with cancer fall more often? *Oncol Nurs Forum*. 2013 2: 69-78
- Persoon S, Kersten MJ, van der Widen K, et al Effects of exercise in patients treated with stem cell transplantation for a hematologic malignancy: A systematic review and meta-analysis. Cancer Treatment Reviews 2013 39: 682-690
- University of Pittsburgh Medical Center. *Exercising after your stem cell transplant.* Available at http://www.upmc.com/patients-visitors/education/rehab/Pages/exercising-after-your-stem-cell-transplant.aspx. Accessed January 2 2014
- Wise & Brown COPD: J of Chronic Obstructive Pulmonary Disease, 2005;2:125–129

References

- American Cancer Society. Available at www.cancer.org. Accessed January 3, 2017.
- American Cancer Society. Cancer Facts & Figures 2013. http://www.cancer.org/acs/groups/content/@epidemiologysurveilance/documents/document/acspc-031941.pdf. Accessed 09/03/12, 2012.
- American Cancer Society. What are the key statistics about breast cancer? 2012; http://www.cancer.org/Cancer/BreastCancer/DetailedGuide/breast-cancer-key-statistics. Accessed 08/23/12, 2012.
- Bajwa, Zahid MD, Carol Warfield MD. Pharmacological therapy of cancer pain. 2005. Available at: Baumann FT, Kraut L, Schule K, Bloch W, Fauser AA. A controlled randomized study examining the effects of exercise therapy on patients undergoing haematopoietic stem cell transplantation. *Bone Marrow Transplantation*. 2010;45(2):355–62.
- Baumann FT, Zopf EM, Nykamp E, Kraut L, Schule K, Elter T, et al.Physical activity for patients undergoing an allogeneic hematopoietic stem cell transplantation: benefits of a moderate exercise intervention. *European Journal of Haematology*. 2011; 87(2):148–56.
- Bergenthal N, Will A, Streckmann F, Wolkewitz KD, Monsef I, Engert A, Elter T, Skoetz N. Aerobic physical exercise for adult patients with hematological malignancies (Review). *The Cochrane Library*. 2014 (11): 1-55.
- Bhuyan, C, Saikia, B, Choudhury, N. Oncological emergencies-management guidelines for clinicians. Journal of the Indian Medicine Association. 2005. 103:474-8.
- Breast Cancer.Org. Available at: http://www.breastcancer.org/. Accessed August 22, 2016.
- Cancer Quest. Emory University Available at www.cancerquest.org. Accessed January 3, 2017.
- Cappiello J, Piazza C. The spinal accessory nerve in head and neck surgery. *Curr Opin Otolaryngol Head Neck Surg*. 2007;15(2):Coleman, EA, Coon, SK, Kennedy, RL, Lockhart, KD,Stewart, CB, Anaissie, EJ, Barlogie, B. Effects of exercise in combination with Epoetin Alfa during high-dose chemotherapy and autologous peripheral blood stem cell transplantation for multiple myeloma. *Oncology Nursing Forum*. 2008; 35 (3):53-61.
- Coleman, MS. Basic oncology for the physical therapist. Rehab Oncology. 1999;17:29-31.
- Convertino VA, Bloomfield SA, Greenleaf JE. An overview of the issues: physiological effects of bed rest and restricted physical activity. *Med Sci Sports Exerc.* 1997; 29:187–190.
- Courneya, KS. Mackey, JR,. Jones, LW. Coping With Cancer. Can Exercise Help? Physician and Sportsmed. 2000; 30:33.
- 107-11.
- Cuccia G, Shelley OP, Stagno F, et al. Evidence of significant sternocleidomastoid atrophy following modified radical neck dissection type III. *Plast Reconstr Surg*. 2006;117(1):227-232.
- Davis AM, Dische S, Gerber L, et al. Measuring postirradiation subcutaneous soft-tissue fibrosis: state-of-the-art and future directions. *Semin Radiat Oncol*. 2003;13(3):203-213.
- DeVita, Jr V T.., T S. Lawrence, SA. Rosenberg. DeVita, Hellman, and Rosenberg's Dimeo FC, Tilmann MH, Bertz H, Kanz L, Mertelsmann R, Keul J. Aerobic exercise in the rehabilitation of cancer patients after high dose chemotherapy and autologous peripheral stem cell transplantation. Cancer. 1997;79:1717-1722.
- Dimeo F, Stieglitz RD, Novelli-Fischer U, Fetscher S, Mertelsmann R, Keul J. Correlation between physical performance and fatigue in cancer patients. *Ann Oncol*. 1997;8:1251-1251.
- Dimeo FC, Tilmann MH, Bertz H, Kanz L, Mertelsmann R, Keul J. Aerobic exercise in the rehabilitation of cancer patients after high dose chemotherapy and autologous peripheral stem cell transplantation. Cancer. 1997;79:1717-1722.
- Donnelley CH, Wilton J. The effect of massage to scars on active range of motion and skin mobility. *Br J Hand Ther*. 2002;7:5-11.
- Drouin J, Pfalzer L. Aerobic exercise guidelines for the person with cancer. *Acute Care Perspectives*. Journal of the Acute Care Section of the American Physical Therapy Association. 10; 1 & 2: Spring/Summer 2001.

References

- Fialka V, Vinzenz K. Investigations into shoulder function after radical neck dissection. J Craniomaxillofac Surg. 1988;16:143-147 Gillette EL, Mahler PA, Powers BE, et al. Late radiation injury to muscle and peripheral nerves. Int. J. Radiation Oncology Biol. Phys. 1995;31(5):1309-1318.
- Fernandez-Lao, C., et al., Effectiveness of a multidimensional physical therapy program on pain, pressure hypersensitivity, and trigger points in breast cancer survivors: a randomized controlled clinical trial. Clin J Pain. 28(2): p. 113-21.
- Goodman C.and Kelly-Snyder, TE. Oncology in Pathology: Implications for the Physical Therapist. Catherine C. Goodman, William G. Boissonnault, Kenda S. Fuller (ED). 2nd edition, Saunders, 2003.
- Goodman CC, Boissonnault WG, Fuller KS. Pathology: Implications for the Physical Therapist 2nd Edition. Philadelphia, PA: Saunders; 2003.
- Grandi G, Luciano-Silva M, Streit C, et al. A mobilization regimen to prevent mandibular hypomobility in irradiated patients: an analysis and comparison of two techniques. Med Oral Patol Oral Cir Bucal. 2007;12:E105-109.
- Guyton A, Hall E. Textbook of Medical Physiology. W.B. Saunders Company, Chapter 1, 2006.
- Guide to Physical Therapist Practice Second Edition. Phys Ther. 2001.
- Harrington S, Michener LA, Kendig T, Miale S, George SZ. Patient-Reported Shoulder Outcome Measures Used in Breast Cancer Survivors: A Systematic Review. Arch Phys Med Rehabil. 2014;95(1):153-162.
- Hicks, J. Exercise for Cancer Patients. In Therapeutic Exercise. JV Basmajian and SL Wolf (ed). 5th edition, Williams and Wilkins. 1990.
- Horner MJ, Ries LAG, Krapcho M, Neyman N, Aminou R, Howlader N, Altekruse SF, Feuer EJ, Huang L, Mariotto A, Miller BA, Lewis DR, Eisner MP, Stinchcomb DG, Edwards BK (eds). *SEER Cancer Statistics Review, 1975-2006*, National Cancer Institute. Bethesda, MD, http://seer.cancer.gov/csr/1975_2006/, based on November 2008 SEER data submission, posted to the SEER web site, 2009.
- Howlader N, Noone AM, Krapcho M, Neyman N, Aminou R, Altekruse SF, et al.SEER Cancer Statistics Review,1975-2009 (Vintage 2009 Populations), National Cancer Institute. seer.cancer.gov/csr/1975˙2009˙pops09/, based on November 2011 SEER data submission, posted to the SEER web site (accessed 20th January 2015)
- Inside Cancer. DNA Learning Center Home. (www.insidecancer.org)
- Kleinsmith LJ, Kerrigan D, Kelly J, et al. National Cancer Institute. *Understanding Cancer*. Accessed at: http://cancer.gov/cancertopics/understandingcancer
- Kleinpell R, Fletcher K, Jennings B. Reducing functional decline in hospitalized elderly. In: Hughes RG, ed. Patient Safety and Quality: An Evidence-Based Handbook for Nurses. Rockville, MD: Agency for Healthcare Research and Quality; 2008. Available at: http://www.ncbi.nlm.nih.gov/books/NBK2629/. Accessed January 20, 2014.
- Klemke Lab. (www. klemkelab.ucsd.edu/research/cancer.html)
- Lee, T.S., et al., Prognosis of the upper limb following surgery and radiation for breast cancer. Breast Cancer Res Treat, 2008. 110(1): p. 19-37.
- Park K J et al. Radiation-induced Lung Disease and the Impact of Radiation Methods on Imaging Features. Radiographics 2000;20:83-98.
- McNeely ML, Parliament M, Courneya KS, et al. A pilot study of a randomized controlled trial to evaluate the effects of progressive resistance exercise training on shoulder dysfunction caused by spinal accessory neurapraxia/neurectomy in head and neck cancer survivors. *Head Neck*. 2004;26:518-530.
- Miale S, Harrington S, Kendig T. Oncology Section Task Force on Breast Cancer Outcomes: Clinical Measures of Upper Extremity Function. Rehabilitation Oncology. 2013;31(1):27-34.
- Mock, Victoria DNS. Cancer-related fatigue. NCCN Practice Guidelines in Oncology. 2005; v.2. Available at: http://www.nccn.org. Accessed April 14. 2006Morishita S., Kadia K., Setogawa K., Kajihara K., Ishii S., Ikegame K., Kodama N., Ogawa H<1 & Domen, K. Safety and feasibility of physical therapy in cytopenic patients during allogeneic haematopoietic stem cell transplantation. *European Journal of Cancer Care.* 2013: 22, 289–299.

Thank You for your interest in cancer rehabilitation!