# Neoplasia III: Epidemiology

# Epidemiology Lecture Objectives

- List the most common type of cancer in men and women, and the cancer responsible for the most deaths.

- List the seven most important environmental factors that contribute to the development of carcinoma, and describe a little about each one (e.g., types of associated cancers).

- Define, compare and contrast the three types of hereditary cancer.

- Briefly describe the genetic mutations in Li-Fraumeni syndrome and xeroderma pigmentosum, and explain how they lead to the development of cancer in each disorder.

# Epidemiology Lecture Outline

- Cancer facts
- Environmental factors
- Hereditary cancer

# Cancer Facts

Every year there are:

1.5 million new cases of cancer

>500,000 cancer deaths

Cancer is the 2$^{nd}$ leading cause of death (after heart disease)
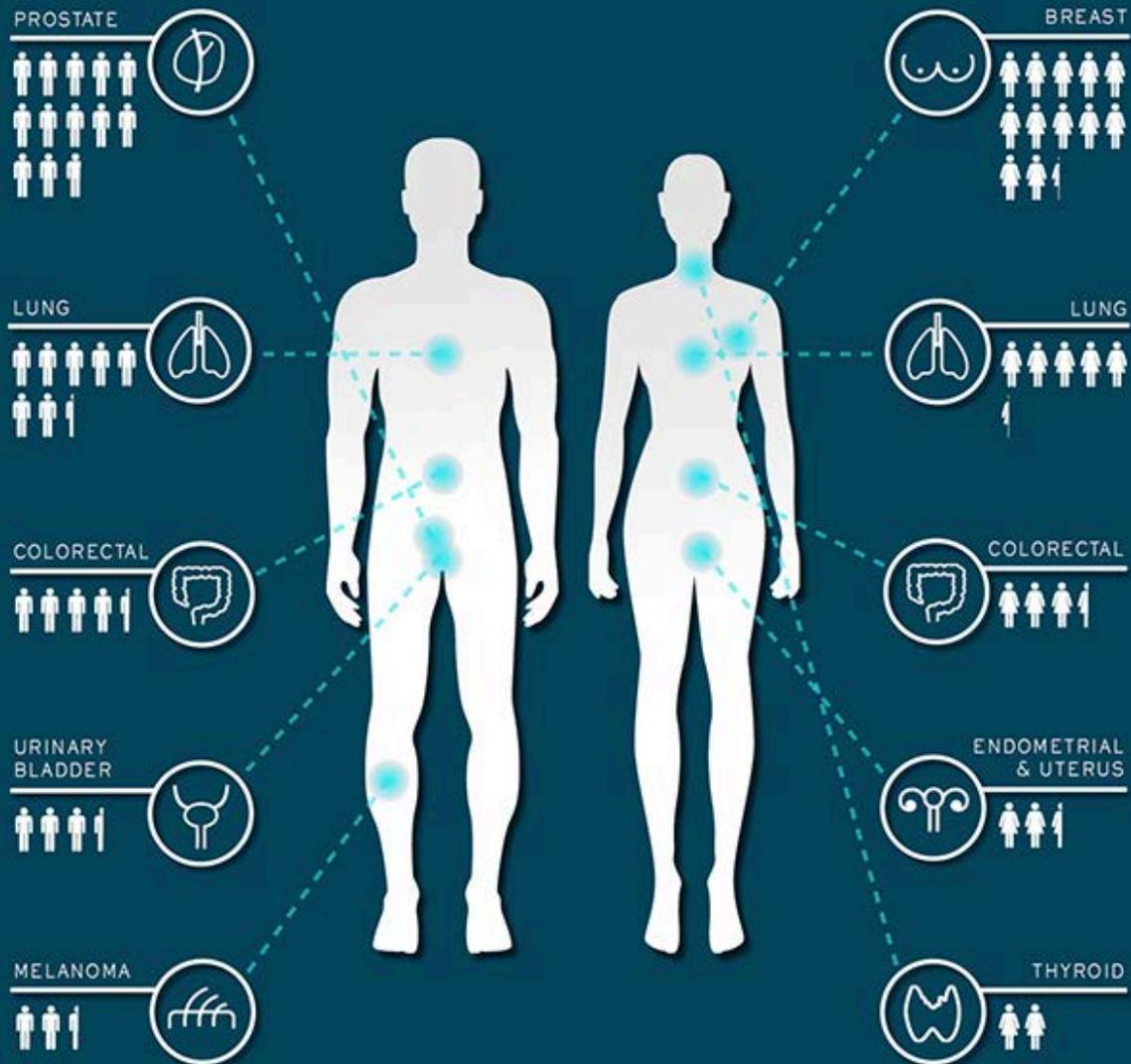
| **Most common cancers** | **Cancers causing the most deaths** |
|---|---|
| Men: Prostate<br>Women: Breast | Men: Lung<br>Women: Lung |

WHAT ARE THE MOST COMMON CANCERS IN *Men* vs *Women*?

PROSTATE

LUNG

COLORECTAL

URINARY BLADDER

MELANOMA

BREAST

LUNG

COLORECTAL

ENDOMETRIAL & UTERUS

THYROID

= 10 per 100,000

# Cancer Deaths

| Males | | Females | |
|---|---|---|---|
| Lung & bronchus | 27% | 25% | Lung & bronchus |
| Colon & rectum | 9% | 14% | Breast |
| Prostate | 8% | 8% | Colon & rectum |
| Pancreas | 7% | 7% | Pancreas |
| Liver & intrahepatic bile duct | 6% | 5% | Ovary |
| Leukemia | 4% | 4% | Uterine corpus |
| Esophagus | 4% | 4% | Leukemia |
| Urinary bladder | 4% | 3% | Liver & intrahepatic bile duct |
| Non-Hodgkin lymphoma | 4% | 3% | Non-Hodgkin lymphoma |
| Brain & other nervous system | 3% | 3% | Brain & other nervous system |
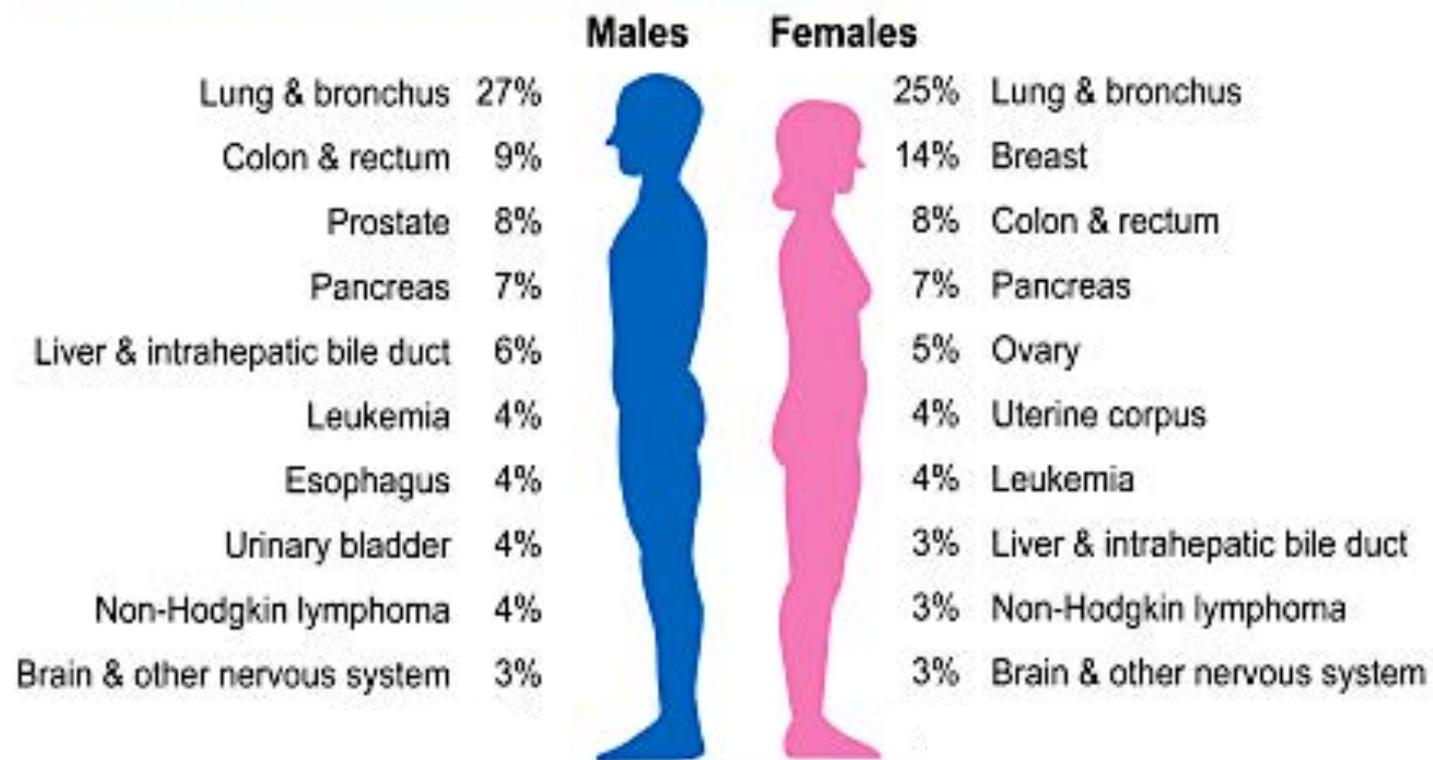
# Five-year survival rates

**10%**
Glioblastoma Multiforme

**18%**
Lung Cancer

**78%**
Triple-Negative Breast Cancer

**8%**
Pancreatic Cancer

**46%**
Ovarian Cancer

# Environmental Factors

"The *single most important environmental factor* contributing to premature death in the US."

HPV

- Infectious agents

- Smoking

Lung, but also oral cavity and pancreatic cancers

Liver, oral cavity, breast

- Alcohol

- Diet          Colon, prostate, breast

- Obesity

↑estrogen exposure

"The most overweight people in the US have over 50% higher death rates from cancer"

- Reproductive history

↓

- Environmental carcinogens

↑ breast and endometrial cancer

  - UV light (skin)
  - Arsenic (lung, skin)
  - Asbestos (mesothelioma)
  - Benzene (leukemia)
  - Radon (Lung)

# Three Types of Hereditary Cancer

- Familial cancers
- Inherited cancer syndromes
- Syndromes of defective DNA repair

# Familial Cancers

- Most cases of cancer are sporadic (random)

- A small number are familial (related to specific germline gene mutations)

- Example: certain BRCA1 gene mutations increase risk of breast, colon, ovary, and pancreatic cancers

- Familial cancers occur earlier and are more aggressive than their sporadic counterparts

# Inherited Cancer Syndromes

- Usually autosomal dominant
- Each has a specific gene mutation that increases risk of getting *multiple* cancers
- Example: Li-Fraumeni syndrome

  - mutation in p53 gene
  - 25x ↑ risk of sarcomas, breast cancer, leukemia, and brain tumors
  - cancers usually appear before age 50

# Syndromes of Defective DNA Repair

- Inherited mutations in genes encoding DNA repair systems
- Greatly enhance the occurrence of mutations in *other* genes ("genomic instability")
- Example: xeroderma pigmentosum

  - Mutations in genes in "nucleotide excision repair" pathway (fixes UV-damaged DNA)
  - Extreme sensitivity to sunlight
  - ↑↑↑ risk of skin cancer (in childhood!)