Oncology 101

Cancer Basics
Presented by Madhuri Bajaj, M.D. | Illinois CancerCare
What Will You Learn?

- What is Cancer and How Does It Develop?
- Cancer Diagnosis and Staging
- Cancer Treatment
Cancer is a group of more than 100 different diseases characterized by the *uncontrolled, abnormal growth of cells*. 
We are made up of cells, which contain genes
First Things First: Normal Cell Division

- Cells grow and divide (copy themselves) to form new cells

- When cells grow old or become damaged, they die and new cells take their place
It all starts in the genes

Adapted from NCI
Under a microscope, cancerous tissue looks very different from normal (healthy) tissue.
Two Main Groups of Cancer

*Blood cancers (e.g., leukemia, lymphoma)*

*Solid tumors (e.g., breast, prostate, colon, lung cancers)*
A tumor is an abnormal growth of cells that forms a mass.

Cancers can begin almost anywhere in the body.
# Benign Versus Malignant Tumors

<table>
<thead>
<tr>
<th>Benign Tumors</th>
<th>Malignant Tumors</th>
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<tbody>
<tr>
<td>Do not spread to other parts of the body</td>
<td>Can invade and destroy the tissue around them</td>
</tr>
<tr>
<td>They can be removed and seldom come back</td>
<td>They can move to other parts of the body and form new tumors there (metastasis)</td>
</tr>
<tr>
<td>Rarely life-threatening</td>
<td>May be life-threatening</td>
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</table>
Major Classes of Cancer

- **Carcinomas** begin in the skin or in tissues covering glands or major organs (80-90% of all cancers; e.g., breast cancer, colon cancer). Major subtypes are adenocarcinoma and squamous cell carcinoma.

- **Sarcomas** begin in the connective tissue such as muscle or bone (Ewing sarcoma). Soft-tissue sarcomas can begin in fatty tissue.

- **Lymphomas** begin in the lymphatic system, a network of glands and vessels that carries lymph and white blood cells (e.g., Hodgkin lymphoma)

- **Leukemias** are cancers of blood-forming tissues including the bone marrow and the spleen (e.g., acute lymphocytic leukemia)
If the cancer spreads, or **metastasizes**, from the place where it started to another part of the body, the metastatic cancer is named for the part of the body where it started.

So, if a melanoma spreads to the liver, it’s called metastatic melanoma, *not* liver cancer.
How Common is Cancer?

- 4 out of 10 Americans will be diagnosed with cancer during their lifetime.
- 1.6 million: The estimated number of new cancer diagnoses in 2016.
- Due to the aging and growing population, by 2030, this number will rise to 2.3 million per year.
How Common is Cancer?

- **14.1 million**: people diagnosed with cancer in 2012
- **22 million**: estimated number of new cancer diagnoses in 2030

*Global Cancer Facts & Figures, 2015*
Cancer is a Leading Cause of Death

- **590,000**: The number of Americans expected to die of cancer in 2016, about 1,600 people per day.
- **8.2 million**: World cancer deaths in 2012 (70% of the world’s cancer deaths occur in developing countries)
- **↑80%**: the estimated increase of world cancer deaths by 2030
Do You Know?

What are the most common types of cancer in the United States?

Worldwide?
Most Common Types of Cancer: 2016 Estimated New US Cancer Cases

<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th>Women</th>
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</thead>
<tbody>
<tr>
<td>Prostate</td>
<td>21%</td>
<td>29%</td>
</tr>
<tr>
<td>Lung &amp; bronchus</td>
<td>14%</td>
<td>13%</td>
</tr>
<tr>
<td>Colon &amp; rectum</td>
<td>8%</td>
<td>8%</td>
</tr>
<tr>
<td>Urinary bladder</td>
<td>7%</td>
<td>7%</td>
</tr>
<tr>
<td>Melanoma of skin</td>
<td>6%</td>
<td>6%</td>
</tr>
<tr>
<td>Kidney &amp; renal pelvis</td>
<td>5%</td>
<td>4%</td>
</tr>
<tr>
<td>Non-Hodgkin lymphoma</td>
<td>5%</td>
<td>4%</td>
</tr>
<tr>
<td>Oral cavity</td>
<td>4%</td>
<td>4%</td>
</tr>
<tr>
<td>Leukemia</td>
<td>4%</td>
<td>3%</td>
</tr>
<tr>
<td>Liver &amp; bile duct</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>All Other Sites</td>
<td>19%</td>
<td>21%</td>
</tr>
</tbody>
</table>

*Excludes basal and squamous cell skin cancers and in situ carcinomas except urinary bladder.
Source: American Cancer Society, 2016.
## Most Deadly Forms of Cancer: 2015 Estimated US Cancer Deaths

<table>
<thead>
<tr>
<th>Cancer Type</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung &amp; bronchus</td>
<td>27%</td>
<td>26%</td>
</tr>
<tr>
<td>Prostate</td>
<td>8%</td>
<td></td>
</tr>
<tr>
<td>Colon &amp; rectum</td>
<td>8%</td>
<td></td>
</tr>
<tr>
<td>Pancreas</td>
<td>7%</td>
<td></td>
</tr>
<tr>
<td>Liver &amp; intrahepatic bile duct</td>
<td>6%</td>
<td></td>
</tr>
<tr>
<td>Leukemia</td>
<td>4%</td>
<td></td>
</tr>
<tr>
<td>Esophagus</td>
<td>4%</td>
<td></td>
</tr>
<tr>
<td>Bladder</td>
<td>4%</td>
<td></td>
</tr>
<tr>
<td>Non-Hodgkin lymphoma</td>
<td>4%</td>
<td></td>
</tr>
<tr>
<td>Kidney</td>
<td>3%</td>
<td></td>
</tr>
<tr>
<td>All other sites</td>
<td>24%</td>
<td>23%</td>
</tr>
</tbody>
</table>

**Source:** American Cancer Society, 2016

- **Men:** 314,290
- **Women:** 281,400
Most Common Cancers

Lung
Prostate
Colorectal
Stomach
Liver
Urinary Bladder

Breast
Colorectal
Lung
Cervical
Stomach
Uterine

Global Cancer Facts & Figures, 2015
What Causes Cancer?
Not Those Mutations Again!

- Recall...cancer is caused by changes—mutations—in genes that control the growth and death of cells.

  • Accumulating many of these bad mutations can lead to cancer. No single event turns a normal cell into a cancer cell.
Risk Factors for Cancer

- Certain environmental and lifestyle factors can cause genetic changes (mutations) that lead to growth of cancer.

- These influences are called \textit{risk factors}: A risk factor is anything that increases your chances of getting a disease.

\textbf{Am I at risk?}
Age is the biggest cancer risk factor

Cancer Risk and Aging

Number of Cancer Cases (per 100,000 people)

Age of Person (in years)

Colon
Breast
Research has identified numerous factors that increase an individual's risk for developing cancer. Not all factors have the same impact on cancer risk. The factors with the biggest impact are tobacco use, obesity and overweight, infection with one of several pathogens, lack of physical activity, and poor dietary habits. Adopting healthy approaches to living (see Figure 5) could eliminate or reduce many of these risks and therefore have a tremendous influence on our nation's burden of cancer. Data from (16); figure adapted from (1).
Tobacco causes 18 types of cancer!

171,000: The estimated number of U.S. cancer deaths in 2015 that were due to smoking.

AACR Cancer Progress Report 2013
Healthy Weight and Lifestyle

• **1 in 3**: Cancer deaths due to being overweight, poor diet and/or lack of physical activity

Want to know more about the link between obesity and cancer?

How Can You Reduce Your Risk?

Research has identified numerous factors that affect a person’s risk of developing cancer (see Figure 4). Many of the factors with the greatest influence on cancer risk can be eliminated or reduced by adopting a healthy approach to living. For example, ending tobacco use, eating a healthy and balanced diet, undertaking regular physical activity, reducing exposure to the sun, managing pre-existing medical conditions with the appropriate medications, getting vaccinated against certain pathogens, and developing a personalized cancer screening program with a physician (or physicians) are all part of a healthy approach to living.
Hereditary Cancers

**Sporadic Cancers**
Most cancers (90%-95%) result from a series of *acquired* genetic mutations caused by tobacco, sunlight, radiation, et cetera.

**Hereditary or Familial Cancers**
A small proportion (5%-10%) of cancers--result from mutations passed from a parent (or both parents) to a child.
So, sometimes, you are born with a gene mutation and can pass the mutation to offspring.

This means that you are more likely to accumulate the number of mutations ("hits") needed for development of cancer.

However, even having an inherited gene mutation does not always mean you will develop cancer. But your risk is increased. The rest of the mutations are left up to chance (and exposure).
Hereditary cancer predispositions

- BRCA1, BRCA2 gene mutations (breast, ovarian, prostate, pancreatic and other cancers)
- APC gene mutations (colorectal cancers)
- TP53 gene mutations (breast cancer, sarcoma, leukemia, brain tumors, and other)
- PTEN gene mutations (breast, thyroid, endometrial, other)
- Lynch syndrome (GI and GYN cancers, brain, breast cancer)
- RB1 gene mutation (retinoblastoma, eye cancer)
- Von Hippel-Lindau syndrome (kidney cancer)
Cancer Screening, Diagnosis and Staging Basics

How Do I Find Out If I Have Cancer?

- Signs and symptoms
- Screening tests
- Diagnosis tests
- Incidental (chance) findings
Common Signs and Symptoms

- Nagging cough or hoarseness
- Unplanned weight loss
- Changes in bowel or bladder habits
- New thickening or lump in any part of the body
- Unusual bleeding or discharge
- New mole or obvious change in the appearance of an existing mole or wart
Common Cancer Screening Tests

- Colonoscopy (colorectal cancer)
- Mammography (breast cancer)
- PAP & HPV Tests (cervical cancer)
- PSA (prostate specific antigen; prostate cancer)
- Note that such tests are not widely available in low-resource settings/countries
Uses of Colonoscopy
Mammography
Biopsy, or “Tissue is the Issue”

**Biopsy** - a very small piece of tissue from the abnormal area (solid tumor) is removed and examined under a microscope by a pathologist. In addition, molecular tests can be performed on the tissue.
Biopsy tissue specimens under a microscope (pathology review)
Cancer Staging

Cancer staging is a way of describing the severity of a cancer, such as:

- How large is the tumor?
- Where is it located?
- Has it spread?
The TNM Cancer Staging System

Doctors look at these three factors to determine the stage of cancer:

- How large is the primary tumor and where is it located? (Tumor, T)
- Has the tumor spread to the lymph nodes? (Node, N)
- Has the cancer spread to other parts of the body? (Metastasis, M)
Cancer Stage Groupings I - IV

- Stages are written as Roman numerals one through four (I, II, III, IV).
- Staging helps doctors establish a prognosis and prescribe appropriate therapy.
- A cancer with a lower stage is usually associated with a better prognosis.
Stage I Cancer

Lymph node - - - -

Stage II Cancer

Lymph node - - - -

Tumor

Lymph node metastasis

Right lobe
Left lobe

Lungs

© 2005 American Society of Clinical Oncology
Stage III! Cancer

Lymph node

Media&hal lymph node metastasis

Tumor

Lungs

© 2005 American Society of Clinical Oncology
Metastases

Stage IV Cancer

Metastatic tumor

Primary tumor

Brain

Bone

Liver

Adrenal

Lungs

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IM0MQ Y

Robert Morello/Visual Explanations, LLC

Illinois CancerCare, PC
Specializing in Cancer and Blood Disorders

ASCO
• **Tumor Grade**: describes how much the tumor tissue looks like healthy tissue when viewed under a microscope.

Higher tumor grade usually means more aggressive cancer and worse prognosis.

Gleason scale (score) designates grade of prostate tumor.
What Are the Different Cancer Treatments?
Broad Categories of Treatment I

- **Local therapy** is intended to treat a tumor at the site without affecting the rest of the body. E.g., surgery and radiation therapy.

- **Systemic therapy** refers to drugs which can be given by mouth or directly into the bloodstream (i.v.) to reach cancer cells anywhere in the body (e.g., chemotherapy, hormone therapy, and targeted therapy.)
Sometimes *adjuvant* (additional) therapy is given after surgery or other main cancer treatment to kill cancer cells that may have broken away from the primary tumor and begun to spread through the body by way of the bloodstream.

- **Neoadjuvant therapy**, usually chemotherapy, may be given to shrink a tumor before surgery.
Types of Cancer Treatments

- Surgery
- Radiation Therapy
- Chemotherapy
- Hormonal Therapy
- Targeted Therapies
- Immunotherapy
- Palliative Care
- Supportive Care
Cancer Surgery

- Surgery offers the greatest chance for cure for many types of cancer, especially those that have not spread to other parts of the body. Most people with cancer will have some type of surgery.

- Cancer surgery is done by surgical oncologists or general surgeons, 7% of ASCO membership.
Radiation Therapy

- Radiation therapy uses radiation (high-energy x-rays, gamma rays, neutrons, protons) to destroy cancer cells.

- Radiation may come from a machine outside the body (external-beam radiation therapy), or it may come from radioactive material placed in the body near cancer cells (internal radiation therapy). Radiation therapy is usually a local therapy.
Radiation can be used either as a primary therapy (prostate cancer) or as an adjuvant therapy (breast cancer).

External-beam radiotherapy
Radiation Therapy

- Side effects of radiation therapy include fatigue, swelling, and skin changes.

- Radiation therapy is given by radiation oncologists.
Chemotherapy is the use of drugs to destroy cancer cells.

Chemotherapy is a systemic therapy, or a therapy that targets cells throughout the body.
Chemotherapy

- Chemotherapy works by stopping or slowing the growth of cancer cells, which are rapidly growing and dividing.

- **Side Effects:** Because a lot of *normal* cells in the body also grow and divide rapidly, for instance, cells that line the gut and that cause the hair to grow, a lot of normal cells are also harmed by chemotherapy. This translates into side effects like nausea and vomiting, and hair loss.
How Is Chemotherapy Used?

- Chemotherapy is the main treatment for many blood cancers.
- Chemotherapy is commonly used to:
  - destroy any cancer cells that remain after surgery or radiation therapy and reduce chance of recurrence. This is **adjuvant** chemotherapy.
  - Also used to shrink tumors before surgery or radiation therapy (**neoadjuvant** chemotherapy).
  - Also used to treat recurrent cancer (cancer that has come back in a person thought to be cancer-free) or metastatic cancer (cancer that has spread from the original location).
Chemotherapy

- Chemotherapy generally does not require a hospital stay (inpatient setting); it is usually given in an outpatient setting, including the medical oncologist’s office. Patients can take oral chemotherapy at home.

- Chemotherapy is given by medical oncologists or hematologists.
Hormonal Therapy

Some cancers (e.g., breast, prostate cancers) depend on hormones to grow.

Hormonal therapy blocks these hormones to limit growth of these cancers.

Hormonal therapy is a systemic therapy.
<table>
<thead>
<tr>
<th></th>
<th>Diarrhea</th>
<th>Fatigue</th>
<th>Hair Loss (on the part of the body being treated)</th>
<th>Mouth Changes</th>
<th>Nausea and Vomiting</th>
<th>Sexual and Fertility Changes</th>
<th>Skin Changes</th>
<th>Throat Changes</th>
<th>Urinary and Bladder Changes</th>
<th>Other Side Effects</th>
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<tr>
<td>Brain</td>
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<td>Blurry vision</td>
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<tr>
<td>Stomach and Abdomen</td>
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Precision or Personalized Medicine

- **Targeted treatments** are matched to genetic changes in the tumor.
- Such changes result in abnormal molecules (usually proteins) that cause cells to grow out of control.
- Such abnormal molecules are the “targets,” that can be blocked by targeted therapy.
Different Targets in Lung Cancers

**BEFORE:** One Disease

**TODAY:** Many different forms of lung cancer driven by different molecular defects – with more yet to be identified.
Targeted cancer drugs have been in use for less than 20 years.

American Lung Association
“Targets” can be near the cancer cell, on its surface or inside.
Immuno-oncology (I-O) Is an Emerging Therapeutic Modality

• Traditional therapies for advanced cancer targets the tumour and include\textsuperscript{1,2}
  – Surgery, radiation and cytotoxic/targeted therapy
• Immunotherapy harnesses the body’s own immune system to fight diseases\textsuperscript{3}
• Immuno-oncology (I-O) uses immunotherapy to treat cancer.\textsuperscript{1,2}

Evolution of Cancer Therapy: Treatment Modalities

- Surgery: 1846
- Chemotherapy: 1946
- Radiation Therapy: 1901
- Immuno-oncology: Sipuleucel-T 2010, Ipilimumab 2011
- Targeted Therapy: 1997


Activating T Cells Against Cancer

1. Antigen presentation by dendritic cells
2. Tumor cell recognition and initiation of cytotoxicity
3. Initiating and propagating anticancer immunity
4. Accessing the tumor
5. Cancer cell recognition and initiation of cytotoxicity
6. Tumor cell death
7. Tumor apoptosis
Illinois CancerCare

Clinical Trials Program
WE CURRENTLY HAVE 13 CLINICS IN CENTRAL AND WESTERN ILLINOIS

- Bloomington
- Canton
- Carthage
- Dixon
- Eureka
- Galesburg
- Kewanee
- Macomb
- Ottawa
- Pekin
- Peoria
- Peru
- Princeton

WE ARE MORE THAN CANCER CARE

One of the Firsts for LOCAL TREATMENT
Illinois CancerCare Team

16 Physicians

28 Advanced Practice Nurses (APN)

4 Pharmacists

400+ Staff
Research Department Structure

4 Managers

• Project Manager
• Operations Manager
• Marketing Manager
• Industry Program Manager

6 Administration Staff:

• Regulatory & Compliance Coordinator, Study Start Up Specialist, Budget/Contract Administrator, Business Administrator, Regulatory Coordinator, Administrative Assistant

17 front line employees

• 5 Navigator CRAs (screens, consents, enrolls)
• 5 Coordinator CRAs (treats, submits data)
• 3 Cancer Control CRAs (nav + coord duties)
• 1 Registry CRA (handles all registry trials)
• 2 Data Managers (handles observation and survival patients)
• 1 Pharmacy Technician
Percentage of children <5 years of age in a clinical cancer trial: 90%

Percentage of children between 5 and 15 years of age in a clinical cancer trial: 60%

Percentage of adults in a clinical cancer trial: 3%

ILCC Enrollment: 6%
Sources of Clinical Trials

➢ Grant Sponsored Research
   National Cancer Institute National Community Oncology Research Program (NCI NCORP)

➢ Industry Sponsored

➢ Investigator Initiated Trials

➢ Consortiums
Research Over the Years

1977: Research Begins! Illinois Oncology Research Association (IORA) is established and becomes one of the original NCCTG member institutions. IORA enrolls their 1st pt on a clinical trial on 1/29/1979.

1978: OHACI Practice Established
Following completion of his oncology fellowship at Mayo Clinic, Dr. Stephen Cullinan returned home to begin his private practice – Oncology Hematology Associates of Central Illinois (OHACI).

1983: CCOP Era
OHACI, in partnership with Methodist Medical Center, becomes one of the 1st Community Clinical Oncology Programs (CCOP) in the nation bringing cutting edge research close to home.

1987: OHACI Becomes ILCC
The practice name is changed from OHACI to Illinois CancerCare, P.C. (ILCC).

2004: Research Today
ILCC Research program continues to grow! With over 10,000 patients enrolled on clinical trials, ILCC is recognized as both a leader and expert in oncology research.

2008: NCORP Launches
NCI discontinues CCOP after 30+ years. This program was succeeded by the NCI Community Oncology Research Program (NCORP). ILCC joins forces with 2 former CCOPs to establish the Heartland NCORP.

2019
Industry vs NCORP

Clinical Trial Menu: 80% NCORP and 20% Industry/Consortium

NCI Community Oncology Research Program
- NCI grant funded
- 46 national networks/ 7 research bases
  - 9000 health professionals; > 1000 sites (US, PR, Guam)
- Prevention, Screening, Treatment, Supportive Care/QOL, Surveillance, CCDR

Heartland Cancer Research NCORP
www.heartlandncorp.com
Heartland Cancer Research NCORP

Affiliated with multiple NCI-sponsored research bases and cooperative groups, including:

- Alliance for Clinical Trials in Oncology (Alliance)
- Cancer Trials Support Unit (CTSU)
- ECOG-ACRIN
- NRG Oncology
- Southwest Oncology Group (SWOG)
- University of Rochester Cancer Center (URCC)
- Wake Forest University Comprehensive Cancer Center
Over 100 clinical trials available

<table>
<thead>
<tr>
<th>AML</th>
<th>CLL</th>
<th>Multiple Myeloma</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anal</td>
<td>CML</td>
<td>NSCLC</td>
</tr>
<tr>
<td>APL</td>
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<td>Carcinoid</td>
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*Full menu available on IllinoisCancerCare.com/research
WE ARE CANCER CARE.
COMMITTED TO YOU.

Illinois CancerCare