Cancer
Cancer: 2nd leading killer

• 1 in 2 men, 1 in 3 women: in North America: cancer during life
LEADING CANCER KILLERS

- Lung: 90,810
- Breast: 28,660
- Colon & Rectum: 24,260
- Pancreas: 17,500
- Ovary: 12,570
- Non-Hodgkin Lymphoma: 12,460
- Leukemia: 11,250
- Esophagus: 9,790
- Bladder: 9,950
- Liver: 8,100
- Kidney: 7,420
- Brain: 7,420
- Myeloma: 5,400
- Skin (Melanoma): 5,400
- Oral Cavity & Pharynx: 5,210
- Larynx: 2,910

Estimated number of cancer deaths for 2008.

What is cancer?

• Uncontrolled growth/spread of abnormal (malignant) cells: “out of control”
• Your body: 100 trillion cells
• Baby → child → teen → adult
• Cells divide rapidly, growth, adult size
• Adult cells “maintenance mode”
• Divide only: replace dead cells or injury
• Normally delicate balance:
  cell growth ↔ “programmed cell death”
  (apoptosis- orderly process)
• Example: UV damage skin:
  peeling
Cancer cells

- No controls to stop dividing
- Crowd out normal cells
- Compete normal cells: nutrients
- Cancer cells $\rightarrow$ tumor $\rightarrow$ destroy normal cells
Cancer cells *spread* - blood & lymphatic system → other tissues

**Metastasis:** 90% cancer deaths

Melanoma chewing through skin collagen
A tumor grows from a single cancer cell. Cancer cells invade neighboring tissue. Cancer cells spread through lymph and blood vessels to other parts of the body.

Figure 8.10 Growth and metastasis of a malignant tumor of the breast.
Benign (harmless, non-cancerous)

- Tumor: cells grow locally, don’t damage healthy tissue

This slide shows normal tissue cells. The cells are oval shaped, with all of the cells looking similar. They’re very well organized into a single layer of cells.

This slide shows cancer cells. Cancer cells are stacked up and highly disorganized. They also look very different from each other.

This slide shows a benign tumor (fibroadenoma). Unlike cancer, the cells remain well-formed. Benign tumors also don’t invade normal surrounding tissue.
Cancer Cells Live Forever In Vitro
1951 Henrietta Lacks died aggressive **cervical cancer** at Johns Hopkins Baltimore

- Doc snip- **cervical tissue:** gave to researcher
- Family **not** notified
- Her cells “Multiplied like crazy and never died” **in vitro** (NY Times 2/2/10)
- Her cells: “**immortal**”
• Named HeLa cell line
• HeLa cells research:
  1. 1st Polio vaccine
  2. Went into outer space: study: zero gravity
  3. Drug development: Parkinson’s, leukemia, influenza
2001: Her daughter told about HeLa cells
- Held *frozen vials* of her mother’s cells at Johns Hopkins
- Since 1951, tons of HeLa cells sold for research for $millions profits by company
- Family received *nothing*
- Today questions: “tissue rights” & informed consent
200 different types- cancer

Major types

- **Carcinomas**: start on outside/inside **surfaces**- skin/colon (common)
- **Sarcomas**: start- bone/muscles
- **Lymphomas**: start- lymph nodes
- **Leukemias**: origin bone marrow- blood
Slow Development

• Most cancers: 5-40 years after exposure to cancer-causing agent (carcinogen)

• Lung cancer: 25 years after you start smoking
What causes cancer?

Bad combos: **Interaction: lifestyle, environment, genetics**

- Some genes (DNA) normally regulate cell division/repair
- Have “potential” to start cancer: **proto-oncogenes**
  - Proto= Greek: “first”
  - Oncos= Greek: “mass/tumor”
3 steps- cancer development

1. **Initiation**: DNA mutated

2. **Promotion**: mutated cell divides *uninhibited* (no brakes)

3. **Progression**: cancer cells grow out of control: invade healthy tissue, *metastasize*
Initiation →
Promotion →
Progression →

Figure 6.11  Cancer cells develop as a result of a genetic mutation in the DNA of an undifferentiated cell. The mutated cell replicates uncontrollably, eventually resulting in a tumor. If not destroyed or removed, the cancerous tumor metastasizes and spreads to other parts of the body.
Damage to DNA

• Converts proto-oncogenes to 
**oncogenes**

• Normal cells → oncogenes → Cancer cells

• Other genes: “tumor suppressor”
  Stops abnormal cell growth (brakes)

• Mutation this gene- no longer 
  **guards** against cancer
Suppressor gene: on or off

*Melting away.* With the *p53* gene off, liver tumors transplanted into mice grow to an advanced stage as indicated by the red color, but the tumors begin to shrink as soon as *p53* is activated.
What do carcinogens do?

1. Some: damage DNA (key genes) and cause mutations = tumor initiators

2. Others: stimulate cells to divide: tumor promoters
Damage to DNA

1. **Chemicals** (Erin Brockovich, Woburn, Civil Action)
Radiation: Good and Bad Effects

- CT Scans (3-D image)
- 2010 study: screening of heavy smokers
- **Early detection**
- ↓ 20% Lung cancer death risk
- **2010 British/Swedish Study:** mammography screening women in 40’s: ↓ 26% breast cancer death
Radiation to **treat** cancer: **Overdoses**

**1000 mistakes** over 10 years - computer software/human errors in radiation beam - linear accelerators: loss of hair, redness, death
Damage to DNA

2. **Radiation**: ↑ radiation doses
    ↑ cancer

Examples: Hiroshima, Nagasaki, Chernobyl, UV (sun)
X-rays: carcinogens: World Health Organization, Centers Disease Control
“Atomic Cameramen”

Secret Moviemakers
Nevada Desert 1957

• Filmed atomic bombs
• Knocked cameraman + camera into ditch

• Many died from cancer
X-rays: leukemia, thyroid, breast, lung cancers

• Americans- greater exposure to radiation today vs. past
• Medical imaging > natural background radiation
• CT scans > standard X-ray
• Avoid full body CT scans
• Keep track: cumulative exposures
Radiation: 1 CAT scan = 400
Chest X-Rays
# Radiation Risk

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Radiation Exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>X-ray of the head</td>
<td>Typically .07 mSv, equivalent to 4 chest X-rays</td>
</tr>
<tr>
<td>CT scan of the head</td>
<td>Typically 2 mSv, equivalent to 100 chest X-rays</td>
</tr>
<tr>
<td>Barium enema (for visualizing the colon)</td>
<td>Typically 7 mSv, equivalent to 350 chest X-rays</td>
</tr>
<tr>
<td>CT scan of abdomen</td>
<td>Typically 10 mSv, equivalent to 500 chest X-rays</td>
</tr>
</tbody>
</table>

Radiation exposure, measured in millisieverts (mSv), varies depending on the body part, type of procedure, and equipment used to perform the scan. One federal report estimated that a typical chest X-ray (●) exposes a patient to .02 mSv. The average person is exposed to 3 mSv of natural radiation per year, so one chest X-ray equals 2.4 days (●) of natural radiation exposure. Here is how that compares to the exposure of other diagnostic procedures involving radiation.

- **28.5 days** of natural radiation exposure (X-ray of the head)
- **243 days** of natural radiation exposure (CT scan of the head)
- **2.3 years** of natural radiation exposure (barium enema)
- **3.3 years** of natural radiation exposure (CT scan of abdomen)

*Source: US Food and Drug Administration*
Concern: "Super X-Rays"

Needless CAT scans—especially children

Cumulative effect $\uparrow$ cancer risk

1/3 diagnostic tests: may not be necessary
1986: Chernobyl (Ukraine): nuclear reactor meltdown

- **Plume**: radioactivity (Iodine 131) taken up by **thyroid**
• 4 years later dramatic ↑ thyroid cancer children - Gomel, Belarus-north of Chernobyl

• Children vulnerable radiation-induced thyroid cancer (radiosensitive)

• Direct link: radiation & cancer
Damage to DNA

3. Tobacco use (Babe Ruth)
Passive smoking causes lung cancer in non-smoker
Damage to DNA

4. **Viruses** (papilloma virus- cervical cancer, Gardasil- new cancer vaccine)
5. Genetics

80-90 % cancers: no family history

But if family history: more frequent, earlier it occurs in relatives: greater your risk
Family history: may increase your risk

Examples: cancer susceptibility genes identified

A) Colon cancer
B) Prostate cancer
C) Breast cancer
Genetic Testing

- BRCA1 & BRCA2

Gene mutations

Women
- 56-87% risk breast cancer
- 27-44% risk ovarian cancer
- 2-4% risk pancreatic cancer

Men
- Risk: breast, pancreatic, prostate
Young people & cancer

• People 15-39: cancer 4th leading killer
• Testicular cancer rate: increasing-young men
• Thyroid cancer- increasing- young people
Do young people have “distinctive biologies” making them more likely to die from cancer?
Young people & cancer

• Diagnosed later stages - cancer
• Don’t get routine screening - like older adults
• Young people & doctors don’t expect cancer
Young people & cancer

• Causes unclear. Few clinical trials. Genetics, environment? Some young people predisposed - cancer

• Huge psychological challenges: cancer + finishing school, career, starting family
Profile: Dr. Jeff Carenza 29: St. Louis radiology resident, avid runner

• Weekend: girl friend & he: Miami-food poisoning → hospital
• Tests: iron deficiency anemia
• Gastroenterologist: “colonoscopy—waste of time”

• Result: large tumor in colon—so big—couldn’t get around it with scope

• No family history cancer

• Chemotherapy—now remission
Profile: Asha Mevlana: 22, Los Angeles: lump in breast

- Mammogram: inconclusive
- Doctor: “Don’t worry, you’re too young for breast cancer.”
- Two years later: lump grew - diagnosis: breast cancer
- Survivor: 31 years old (2007): professional violinist
Profile: Lauren Terrazzano- Writes “Life with cancer” for Newsday

• “Cancer can be ultimate form of identity theft”
• 36 years old- advanced lung cancer (2004),
  3 surgeries
• Advocacy/support: imtoooyoungforthis.org
Cancer clusters: random chance or something else?

- Environment, lifestyle, genetics?

- **Epidemiology**: study of patterns of disease distribution (occurrence)
World Health Organization 2008: **Night Shift**: a “probable” carcinogen

Breast & prostate cancer: people working-night

Cause? Effect?

Changes- Biological clock (circadian rhythm)
Women in Northeast: greater deaths from breast cancer than rest of U.S.

Breast cancer death rates

Geographical variations in the death rate from breast cancer, a new study says, are related to lifestyle differences rather than environmental factors. (The map shows only deaths among white women, from 1970 to 1992, since sample sizes for minorities were inadequate.) The National Cancer Institute study found most of the increased risk in the Northeast was attributable to known risk factors such as alcohol consumption and waiting longer to have children.

Deaths per 100,000 white women
- 29.5 to 33.5
- 28.1 to 29.4
- 27.0 to 28.0
- 25.3 to 26.9
- 23.5 to 25.0
- 28.1 to 29.4
- 27.0 to 28.0
- 25.3 to 26.9

SOURCE: National Cancer Institute, Division of Cancer Epidemiology and Genetics; National Center for Health Statistics; Census Bureau
Possible reasons: 87% risk

- Wait longer to have children
- Have no children
- Have menopause later
- ↑ Alcohol intake

13% risk: unexplained
Women who Breastfeed Babies

↓ Risk of breast cancer (before menopause) & ovarian cancer vs. women who don’t breastfeed
Boston neighborhoods & cancer

• Poorer Bostonians: get more cancer & die from it (1998 study)
• Factors: smoking, screening, racial differences, exercise, health education
1997 study: breast cancer rates- Cape towns higher than state average

- Health officials looked at pesticides, solvents, chemicals
- Cape drinking H2O: near surface aquifer
• Cheryl Osimo, 41: breast cancer: no family history; coordinator- Silent Spring- looking at environmental factors causing cancer
Lifestyle: Low risk cancer groups

• 7th Day Adventists: vegetarians, high fiber diet, no cigarettes, no alcohol
• Mormons: no smoking, alcohol, nutritious diet
• Vegetarians: also ↓ risk: obesity, diabetes, heart disease, hypertension
Population Studies

- People move from low cancer risk country → high risk country
- Acquire cancer rate: new country
- Japan ↑ risk stomach cancer
- US ↑ risk colon cancer
- Japanese → US ↑ colon cancer
Population Studies

Rural African populations: high fiber diet, rarely see colon cancer

• Move to cities, low fiber diets:
  ↑ colon cancer

Hispanics: Mexico, Puerto Rico, Cuba
Lower overall cancer rates than non-Hispanics

• Move to U.S. (Florida)

•↑ Cancer Rates  ? Lifestyle changes
Cancer Warning Signs

- Changes - bowel/bladder habits
- Sores - don’t heal
- Unusual bleeding/discharge
- Lumps in breast/elsewhere
- Indigestion/difficulty swallowing
- Changes - warts/moles
- Nagging cough/hoarseness
Cancer: Specific Warning Signs

- Breast cancer
- Cervical cancer
- Colorectal cancer
- Endometrial cancer
- Lung cancer
- Prostate, skin, testicular, throat, urinary tract/bladder
How do you treat cancer?

• Surgery

• Radiation

• Emerging Therapies: gene, laser, molecular-directed against specific cancer cell enzyme/protein
Melanomas: skin cancers have specific gene mutations (oncogenes): activate chemical pathway: ↑ mitosis
2010 Massachusetts General Hospital and other US medical centers

Study: Patients with metastatic melanoma

• Use oral inhibitor of cancer pathway

• Called “Oncogene Targeted Therapy”

• 15 days after treatment: majority patients: complete or partial tumor regression
Before pills
(Pet Scans)

After
Two California cousins in study: Thomas McLaughlin (24) (left)- on pills 2 months- tumors stop growing
“Dude you have to get on these superpills”
Cousin- Brandon Ryan (22) (right)
In Control group
Started debate among cancer Docs
How do you treat cancer?

- Chemotherapy
- **Immunotherapy**: increases body’s natural immune reaction: cancer cells (example - vaccines)
- **Hyperthermia therapy** (106 F)
- **Cryotherapy** (very cold - liquid nitrogen)
How do you treat cancer?

• Angiogenesis inhibitors

  *Angiogenesis* = formation new blood vessels

• Nexavar - new liver cancer drug:
cuts off blood supply - tumor
Pancreatic Cancer ↑ Risk: smoking, family history, being overweight, sedentary lifestyle

No reliable screening tests

Patrick Swayze
Pancreatic Cancer: Deadliest of cancers

• Unlike most other cancers: pancreas cancers: “devascularized” (only 10% normal # blood vessels)

Difficult to treat with drugs

• 4 hours/week brief walk: reduces risk in overweight/obese people
Brain Cancer

Glioblastoma (Senator Kennedy)

Dennis Sugrue - Connecticut:

had surgery,
chemo, radiation

But: tumor grew back
New Treatment

Thread microcatheter into brain blood vessels near tumor

- Inject **mannitol** (sugar alcohol - chewing gum)
- Opens **“blood brain barrier”** (tight cells in capillaries - natural defense)
2d: spray **Avastin**
Directly into brain-
High dose

- **Starves tumor**
- Blocks new blood vessel formation
- MRI scans: tumors **fade away**
Vanishing Cancers

2009 JAMA study

Some cancers: stop growing, shrink, disappear

- Young man: testicle lump, remove testicle: Docs see scar, no tumor
- Some precancerous cervical cells: change back to normal
- Some breast cancers: disappear
- Growing evidence: some cancers can go backward
How do you prevent cancer?

• Don’t smoke/use tobacco (30% cancer deaths): mouth, larynx, lung, esophagus, bladder, kidney

  Tobacco smoke: 40 different carcinogens, radioactivity
Cigarette Smoke:

Radioactivity:

Polonium

Smoke 1.5 packs/day = 4 chest X-rays
How do you prevent cancer?

• Eat healthy diet: 1/3 cancer deaths related to diet
  Stomach, colon, rectum, prostate, uterus, breast

• 2009 Policy & Action for Cancer Prevention Report: 1/3 U.S. Cancers are Preventable
How do you prevent cancer?

• Be **physically active**: control your weight

  Obesity: ↑ risk prostate, colon, rectum, uterus, breast cancers

• ↑ Exercise  ↓ Cancer risk

• Breast cancer **survivors**:

  Exercise (3-5 hr/week):

  ↓ fatigue/pain  ↓ 40% cancer death
“A lifetime of regular exercise may reduce a women’s risk of breast cancer late in life”

Exercise

Body estrogen
How do you prevent cancer?

• Protect your **skin** from sun: skin cancer

Sunburns children → **melanoma** later in life
How do you prevent cancer?

• **Limit alcohol** ↑ risk cancers: mouth, pharynx, esophagus, larynx. Maybe also: liver, breast, colon, rectum, stomach

• **Deadly combo**: smoking + alcohol (cancers: mouth, esophagus, larynx)
How do you prevent cancer?

- Avoid environmental/occupational carcinogens: second-hand smoke, Air/H2O/workplace pollutants
- Workers- small paint brushes with radium touch to lips- fine point
- Paint wrist watches- luminescent
- ↑ Lip cancer
Aspirin & Cancer

• People who take aspirin Regularly ↓ Risk colon tumors

• People diagnosed with colorectal cancer

• Start taking aspirin: ↓ 47% risk dying from cancer
Preventing Cancer’s Return

1. Colon cancer survivors

↑ fruits/veggies, fish, legumes

↓ Risk - cancer return

VS.

↑ Red/processed meat, desserts, fries, refined grains

↑ Risk (3X)
Preventing Cancer’s Return
Women breast cancer survivors

5 fruits & veggies/day + physically active ↓ Recurrence
fat intake ↓ Likely to die ↓ (50%)
Preventing Cancer’s Return

Men with prostate cancer

† Vegetarian diet
  † Chances survival

2009 Swedish study: obese men (apple pattern)

† Risk aggressive prostate cancer

Lose weight ↓ Risk
Breast Cancer: Screening (mammograms)

2009: Recommendations of US Preventive Services Task Force

• Low risk women: breast cancer screening age 50 not 40

• Women 50-74: mammograms every 2 years not once/year

• Advise against: regular breast self-exam

Currently: American Cancer Society, National Cancer Institute, AMA: screening age 40: every 1 or 2 years
Critics of Recommendations

Dr. Marisa Weiss, Ms. Karen Young-Levi

Breastcancer.org
Diet & cancer

• 1/3 cancer deaths: related- diet
• Obesity: 14% cancer deaths-
  men
  20% cancer deaths-
  women
Women, Weight & Cancer

Extra Weight & Cancer Risk (Women)

Relative Risk of Dying

BMI

- Normal
- Overweight
- Obese

Uterine
Kidney
Breast
Men, Weight & Cancer

Extra Weight & Cancer Risk (Men)

Relative Risk of Dying

BMI

18.5-24.9 Normal
25.0-29.9 Overweight
30.0-34.9
35.0-39.9 Obese

Colorectal
Kidney
Esophageal
Fight cancer with colors: phytochemicals

Eat Your Colors Every Day To Stay Healthy & Fit

*Diets rich in fruits and vegetables may reduce the risk of some types of cancer and other chronic diseases.

Foods that are high in phytochemicals are easy to recognize by their bright colors.
Cancer prevention foods: Eat these Whole Food instead of pills

• Fruits & veggies-rich in:
  1) Antioxidants (beta carotene, vitamins C & E): protect DNA from oxidative damage
  2) Phytochemicals (biologically active chemicals- plants)
  3) Large doses Vitamin E no decrease cancer risk
Cancer prevention foods: **Eat these**

- **Lycopene** (carotenoid)- **tomatoes**: **may** prevent prostate/pancreatic cancer: **men**

- **Recent studies**: **No relationship**: **Lycopene & cancer**
Cancer prevention foods: **Eat these**

- **Cruciferous veggies**: broccoli, Brussels sprouts, cauliflower - prevention: lung cancer

- **Berries & red grapes**
Cancer prevention foods: **Eat these**

- **Onions, garlic:** decreases colon, rectum, ovaries, prostate, breast, kidney, esophagus, mouth, throat

- **Green leafy veggies & root veggies (carrots, sweet potatoes):** decreases stomach cancer
Cancer prevention foods: **Eat these**

- **Vitamin A, beta carotene** rich foods: ↓ stomach cancer

- **↑ Calcium** maybe ↓ colorectal cancer

But: high calcium: maybe ↑ prostate cancer risk

Eating more fruits and vegetables has been shown to reduce the risk of several cancers.
Caution: high beta carotene supplements

↑ lung cancer

Cigarette smoking decreases bone density and is a risk factor for osteoporosis.
Cancer prevention foods: **Eat these**

- **Vitamin D:** women 200 IU/day in diet
  
  ↓ 30% risk: breast cancer
Vitamin D & cancer risk

• Women: sunny places (Atlanta, San Antonio) vs. Northern cities (Boston, Seattle): ↓ 30-40% risk breast cancer

• Women outdoors (work/play): ↓ risk vs. women indoors

• ? ↑ Sun ↑ Vitamin D skin: cancer protection
Vitamin D & sunlight- most of US: November-February - Vitamin D: ↓ skin

There goes the sun. In most of the United States, people can't make vitamin D from the sun from November through February.
Vitamin D & supplements: optimal blood level

Vitamin D Status in Primates and Early Humans

- Old-World Primates
- Humans exposing full skin surface to Sunshine’s UVB

Winter
43° N Latitude

“Normal” Blood Levels when taking 1000 IU/day
Northern People Taking 4000 IU/day
Vitamin D and Cancer
2007 Creighton University Study

• Women: supplement 1000 IU/day Vitamin D3 (potent form) + calcium (1400-1500 mg/day)

• ↓ 60% all non-skin cancers

• Other studies: ↑ Blood vitamin D ↓ Colorectal cancer
Canadian Cancer Society Recommendation

1. **1000 IU/day** Vitamin D3 supplement: elderly/dark skin people: Fall/Winter

2. People little sun exposure: **1000 IU/day**: all year

**Diet sources**: fortified milk, OJ, yogurts, margarine, cereals (read labels), salmon, mackerel, sardines, shrimp, egg yolks, liver
<table>
<thead>
<tr>
<th>Food Item</th>
<th>Vitamin D Content (mcg)</th>
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<tbody>
<tr>
<td>Cod liver oil, 1 Tbsp</td>
<td>35.0</td>
</tr>
<tr>
<td>Herring, pickled, 4 oz</td>
<td>12.8</td>
</tr>
<tr>
<td>Salmon, pink, canned, 4 oz</td>
<td>12.8</td>
</tr>
<tr>
<td>Catfish, 4 oz</td>
<td>11.4</td>
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<tr>
<td>Sardines, Atlantic, canned in oil, 4 oz</td>
<td>8.0</td>
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<tr>
<td>Tuna, canned in oil, drained, 4 oz</td>
<td>6.7</td>
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<tr>
<td>Milk, 2%, 1 cup</td>
<td>5.5</td>
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<tr>
<td>Shiitake mushrooms, fresh, 3.5 oz</td>
<td>4.0</td>
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<td>Milk, fat-free, 1 cup</td>
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<tr>
<td>Beef, lean, cooked, 4 oz</td>
<td>0.0</td>
</tr>
<tr>
<td>Butter, 1 Tbsp</td>
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</tr>
</tbody>
</table>

AI for adults 5–15 mcg/day
How vitamin D may work?

• May inhibit cancer cell spread

• ↑ Immune function

• Block angiogenesis

• ↑ Death abnormal cells
2008 study: Women’s Health Initiative

36,000 postmenopausal women

Vitamin D + calcium pills or placebo

After 7 years: no difference in Breast Cancer
Cancer prevention foods: Eat these

- **Whole grains**: ↓ cancer GI tract
- **Fish** rich in omega-3 fats  ↓ colorectal, breast cancers, non-Hodgkin lymphoma
Cancer prevention foods: **Eat these**

- High **fiber** diets: ↓ colon cancer dilute carcinogens, ↓ transit time

- Some studies **don’t** support this finding
Cancer prevention foods: **Eat these**

- Olive oil - Mediterranean diet:
  - Breast, colon, prostate, larynx, ovary, lungs cancers
- Protects DNA - oxidative damage
- Polyphenols - olive oil: stop leukemia cells from growing
Cancer prevention foods: Eat these

• Phytoestrogens: whole grains, veggies, soy products: may protect against uterus, breast, prostate cancers

• Block activity of estrogen in body
2009 Shanghai Women’s Health Study
73,323 Chinese Women
Strong Evidence:
↑ Soy Food Intake
Protection against Premenopausal Breast Cancer
Other studies: no lower cancer risk with soy
Cancer prevention foods: Drink these

• Tea - green & black have polyphenols
  Kill breast, colon, prostate, liver cancer cells

• Also contain flavonoids (pigments):
  protect against viruses

• Dartmouth Study 2007
  1 cup tea/day ↓ skin cancer
Flavonoids

2007 German Study

Onions, black tea, spinach, cabbage

Pancreatic cancer

Smokers: greatest risk reduction
Cancer prevention: foods to limit

- Total fat: fat is tumor “initiator” & “promoter”
  1) Countries: low fat intake, low breast cancer
  2) Women: ↑ fat ↓ fiber ↑ breast cancer
Cancer prevention

Type of fat - important:
Women - Mediterranean countries - olive oil (monounsaturated)

Breast cancer - even though total fat calories similar to US
Cancer prevention: foods to limit

- Trans fat: ↑ breast cancer
- Red meats (high saturated fat) - increase risk: colon & prostate cancers

Instead: white meat, poultry, fish, shellfish
Cancer prevention: foods to limit

• Harvard Nurses’ Health Study II
  Women who ate 1.5 servings red meat/day
  Almost 2x risk: hormone-receptor positive breast cancer
  (most common type)
Women: \[\uparrow \text{Animal (saturated) fat in diet} \]
\[\uparrow \text{Risk of colon cancer} \]
Cancer prevention: foods to limit

- Total calories: ↑ obesity ↑ cancer
• Animal studies: lifelong calorie restriction

↓ spontaneous cancers

↓ aging

↑ life span
Calorie restriction - animals
Rhesus monkey: Canto: 25
445 calories/day
• Nice coat
• Elastic skin
• Smooth walk
• Energetic
• Healthy blood chemistry
• Lived longer
Rhesus monkey: 
**Owen: 26**

885 calories/day

- Bad posture
- Arthritis
- Wrinkled skin
- Frail
- Moves slowly
- Blood: ↑ Glucose
  ↑ Triglyceride
Calorie restriction - humans
In general: people who restrict calories:

↓ LDL ↑ HDL Arteries: little blockage

**Calorie Restriction Society:** goal- to live longer
Mike Linksvayer: 36
San Francisco, Chief Technology officer
Low calorie diet: 6 years
6’ tall 135 pounds
2000-2100 calories/day
Blood pressure: 112/63
Breakfast: apple or cereal
Lunch: small vegetarian dish
Dinner: no bread, rice, sugar
Weekends: occasional fasts
Cancer prevention: foods to limit

• Cooking methods: Heterocyclic amines - carcinogens formed in meat cooked high temperatures/long time (broiling/barbecuing/frying)

• Heterocyclic amines formed from: amino acids + sugar (meat)
PLAYING WITH FIRE
GRILLED CHICKEN CONTAINS CANCER-CAUSING COMPOUNDS

By Jennifer Reilly, R.D.
2006: Physicians Committee for Responsible Medicine

Under California law sued:

McDonald’s, Burger King, Chili’s, Applebee’s, Outback Steakhouse, Chick-Fil-A, TGI Friday’s (Still in courts-2010)

Heterocyclic amines: grilled chicken
Cancer-Causing Compound Found in Grilled Chicken at Chain Restaurants

<table>
<thead>
<tr>
<th>Chain</th>
<th>Item</th>
<th>PhIP?</th>
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<tbody>
<tr>
<td>McDonald's</td>
<td>• Caesar Salad with Grilled Chicken</td>
<td>PRESENT</td>
</tr>
<tr>
<td>Applebee's</td>
<td>• Grilled Italian Chicken Caesar Salad</td>
<td>PRESENT</td>
</tr>
<tr>
<td>Applebee's</td>
<td>• Honey-Grilled Chicken Entrée</td>
<td>PRESENT</td>
</tr>
<tr>
<td>Burger King</td>
<td>• Tendergrill Chicken Sandwich</td>
<td>PRESENT</td>
</tr>
<tr>
<td>Chick-fil-A</td>
<td>• Chargrilled Chicken Sandwich</td>
<td>PRESENT</td>
</tr>
<tr>
<td>Chili's</td>
<td>• Grilled Caribbean Chicken Salad</td>
<td>PRESENT</td>
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<tr>
<td>Chili's</td>
<td>• Guiltless Chicken Platter Entrée</td>
<td>PRESENT</td>
</tr>
<tr>
<td>Outback Steakhouse</td>
<td>• Chicken on the Barbie</td>
<td>PRESENT</td>
</tr>
<tr>
<td>TGI Friday's</td>
<td>• Cobb Salad with Grilled Chicken</td>
<td>PRESENT</td>
</tr>
<tr>
<td>TGI Friday's</td>
<td>• Grilled Chicken Flavor Shots Entrée</td>
<td>PRESENT</td>
</tr>
</tbody>
</table>

Source: Columbia Analytical Services tested 10 samples of each item, using a validated and published analytical method. Every sample from each restaurant tested positive for PhIP. PhIP is one of a group of carcinogenic compounds called heterocyclic amines (HCAs) that are found in grilled meats. In 2005, the federal government officially added HCAs to its list of carcinogens.
• Want **warnings issued about grilled chicken**
• California law: “consumers must be warned about products containing carcinogens”
• USDA: on side of defendants (chickens don’t contain these carcinogens - produced during cooking)
Burger King settles lawsuit- California

Posts warnings: Grilled chicken contains heterocyclic amines

Burger King Warns of Grilled Chicken Cancer Risk
Fast-Food Chain Settles PCRM Lawsuit

Burger King is the first of seven national restaurant chains to settle a lawsuit filed by PCRM over a dangerous carcinogen found in the companies’ grilled chicken. As part of its agreement with PCRM, Burger King has posted warning signs in its California restaurants to alert customers that its grilled chicken products contain PhIP, a cancer-causing compound produced when meats are cooked at high temperatures.
Better grilling to reduce carcinogens

- Use well trimmed meat
- Remove chicken skin
- Marinate meats
- Pre-cook to reduce cooking time on grill
- Don’t char meat
- Cover grill- aluminum foil with holes to reduce charring
Cancer prevention: foods to limit

- Open flame & smoking food: produces hydrocarbons (benzopyrene) - carcinogens
- ↑ Stomach cancer: Iceland, Lithuania - smoked fish
Cancer prevention: foods to **limit**

- **Careful**: Charred, burnt, browned meat
- Women - who eat very well done beef/bacon 4 X greater risk: breast cancer
- **Better**: boiling, baking, poaching (in H2O- near boiling point)
2007 Study in Epidemiology

• Heterocyclic amines & other carcinogens formed: **barbequing, smoking, frying meats - high temps**

• Women who ate grilled, barbequed, or smoked red meat > once/week: ↑ **47%** risk breast cancer over lifetime
Cancer prevention: foods to limit

• Food Additives
  1) **Nitrates & nitrites** - in sausage, ham, bacon, lunch meats
     
     Preserve food (protects against food poisoning (bacteria))
     Adds pink color/flavor
Problem: nitrites + amines (from amino acids) → **nitrosamines** (carcinogen)

All cooked samples of bacon contain nitrosamines
Food Additives

2) Food colors (dyes)

Carcinogens no longer allowed:
Green No. 1 (1966)
Violet No.1 (1973)
Red No. 2 (1976)
Orange B (1978)
Other artificial colors

• Synthetic - not natural
• Being studied - cancer risk
• Found: candy, soda, desserts
• Fenway Frank vs. Yankee hot dog: difference in color
Food Additives

3) Flavorings: outlawed
   safrole (1960)- root beer
   cyclamate (1970) artificial sweetener
Saccharin: 1997 study causes bladder cancer - rats

Politics

Industry/public prevented ban by FDA

Instead: warning label “may cause cancer”

2000: warning label dropped
Mycotoxins

• Metabolites produced by fungus (mold)
• May be present even if you can’t see mold
• **Aflatoxin** - liver carcinogen
• Grains, nuts, peanuts (dry roasting)
If you or are someone you know has cancer .......

• Major concern: cancer cachexia-malnutrition/wasting away

• Cancer - a “parasite”- obtains nutrients, person malnourished

• Similar: protein/calorie malnutrition

• Good nutrition important: fight cancer & withstand treatment
People with cancer

- Fatigue, ↓ energy, weak, loss appetite (anorexia), weight loss
- Due to: cancer and/or treatment
- Side effects: chemotherapy/radiation: damage healthy & cancer cells
People with cancer

1. Malabsorption - food
2. Changes - food tastes/smells
3. Loss - appetite
4. Feeling full
5. Nausea
6. Vomiting
7. Diarrhea & constipation
8. Difficulty chewing/swallowing
People with cancer

Suggestions:
1. Eat little amounts/often
2. Small snacks- rich vitamins/minerals
3. Foods: high protein, calorie-dense
4. Breakfast & lunch main meals-more energy early-day
People with cancer

5. Avoid treatment-empty stomach
6. Avoid fried, greasy foods
7. Foods- easy to digest: oatmeal, noodles, boiled potatoes
8. Avoid foods- strong odors
9. During day: sip juices, sports drinks, broths, peppermint teas
People with cancer

10. Eat **bland foods** - mashed potatoes, rice, yogurt
11. Cut foods - **small pieces**
12. Choose **soft foods**
13. Add gravy, sauces, butter - help swallowing
14. **Avoid highly seasoned, spicy, tart, acidic foods**
People with cancer

15. Create pleasant eating environment
People with breast or prostate cancer

- Drugs: may cause weight gain
- Overeating - stress

Suggestions:
1. Choose lean meat, chicken, turkey, fish, low fat dairy products
People with breast or prostate cancer

2. Eat more fruits & veggies
3. Avoid high fat/calorie snacks: chips/candies/cookies/ice cream
4. Get regular exercise
Dogs & Cancer

• Get cancers similar to humans

• Similar bone metastases

• Cancer: leading cause of death: older dogs
Breeds at risk of cancer

**BREEDS AT RISK**

The breeds represented by the dogs shown here are particularly susceptible to cancers that also afflict humans. These malignancies look like the human forms under a microscope and act similarly as well. Such resemblances mean that canine responses to experimental drugs should offer a good indication of how the compounds will work in humans. In addition, research into the genes that increase susceptibility of specific breeds to particular cancers is expected to help pinpoint susceptibility genes in humans.

- **Rottweiler:** Bone cancer
- **Collie:** Nasal cancer
- **Chow Chow:** Stomach cancer
- **Golden Retriever:** Lymphoma
- **Boxer:** Brain cancer
- **Scottish Terrier:** Bladder cancer

**SKELETAL DISTRIBUTION of metastases is another aspect of cancer similar in dogs and humans.** In dogs, the lesions display the same “above the elbow, above the knee” pattern seen in people. Insights into why that pattern occurs in dogs could help explain the distribution in humans and perhaps suggest new ideas for intervening. (The numbers indicate the number of metastases found at each site in one study.)
Dogs & Cancer

- Cancer research: helps dogs & people
- Enroll pets- drug/medical device trials
- Groundbreaking studies
- Pet owners- best treatments for pets
Dogs & Cancer: research

- Treatments may be applied to humans
- Advantage: shorter studies, 1 year dog’s life = 7 human’s
- Quicker results
- New dog studies: collect DNA & tumor samples; look for cancer genes
Dogs & Cancer

• Basil - 6 year old Golden retriever - "miracle dog"

• "I’m a cancer survivor"

In Trials for New Cancer Drugs, Family Pets Are Benefiting, Too

Basil, a golden retriever, with Kathy Wilber, his owner. The dog survived cancer after participating in tests of a treatment for the disease.
Basil

- Bone cancer: leg amputated
- 11 metastases
- Biotech company: Basil- drug study
- Free of cancer: 3 1/2 years
Dogs can detect cancer

- Dogs - good sense - smell (parts per billion)
- Can sniff cancer

Kobi yellow lab
Dogs can detect cancer

- **Tumors**: release alkanes & benzene derivatives
- Northern California clinic
- Collect *breath samples* in tubes containing wool: cancer patients & healthy volunteers
Dogs can detect cancer

- If dog smelled cancer, trained to sit
- 3 yellow labs & 2 Portuguese water dogs
- 99% accuracy- lung cancers
- 80% accuracy- breast cancers
Dogs can detect cancer

- Other studies: dogs detect cancer-urine samples: people with bladder cancer
Health Benefits of Pets
2009 study underway
Eunice Kennedy Shriver Center- Waltham

Human- animal interactions- anecdotal

1. Autism- service dogs calm children
2. Ill Children in hospitals: anxiety/depression: bring dogs: “brightens them up”
3. Patients (no speech, movement): talk to dogs, reach out to pet
Cancer: The Good News

- Overall: 1999-2005
- **Incidence** new cases
- **Cancer** death rates
- **Men:** prostate, lung
- **Women:** breast cancer
- Both sexes: colorectal
- **Result:** risk factors,
  - screening, newer treatments
- **Some other cancer types**
- **Women:** smoking 60’s, 70’s. Now slower increase in lung cancer
Cancer Deaths: Women

Selected Cancer Death Rates for Women

Lung cancer death rates have soared, while colorectal, stomach, and uterine cancer deaths have dropped.

*Age-adjusted to U.S. population, 1970

Source: American Cancer Society.
Cancer Deaths: Men

The steep rise in adenocarcinoma of the esophagus isn’t yet visible in total esophageal death rates.

*Age-adjusted to U.S. population, 1970  
Source: American Cancer Society.