Principles of Oncologic Surgery

Surgery Grand Rounds
August 31, 2009

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Associate Professor of Surgery
GI Tumor & Endocrine Surgery
University of Colorado Denver
Principles of Oncologic Surgery

Outline

• The cancer problem
• Tumor biology
• Tumor staging systems
• General surgical principles
• Integrating multidisciplinary care
• Future of surgical oncology
# Magnitude of the Problem

## Leading Sites of New Cancer Cases and Deaths – 2009 Estimates

<table>
<thead>
<tr>
<th>Male</th>
<th>Estimated New Cases*</th>
<th>Female</th>
<th>Estimated Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prostate</td>
<td>192,280 (25%)</td>
<td>Breast</td>
<td>192,370 (27%)</td>
</tr>
<tr>
<td>Lung &amp; bronchus</td>
<td>116,090 (15%)</td>
<td>Lung &amp; bronchus</td>
<td>103,350 (14%)</td>
</tr>
<tr>
<td>Colon &amp; rectum</td>
<td>75,590 (10%)</td>
<td>Colon &amp; rectum</td>
<td>71,380 (10%)</td>
</tr>
<tr>
<td>Urinary bladder</td>
<td>52,810 (7%)</td>
<td>Uterine corpus</td>
<td>42,160 (6%)</td>
</tr>
<tr>
<td>Melanoma of the skin</td>
<td>39,080 (5%)</td>
<td>Non-Hodgkin lymphoma</td>
<td>29,990 (4%)</td>
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<tr>
<td>Non-Hodgkin lymphoma</td>
<td>35,990 (5%)</td>
<td>Melanoma of the skin</td>
<td>29,640 (4%)</td>
</tr>
<tr>
<td>Kidney &amp; renal pelvis</td>
<td>35,430 (5%)</td>
<td>Thyroid</td>
<td>27,200 (4%)</td>
</tr>
<tr>
<td>Leukemia</td>
<td>25,630 (3%)</td>
<td>Kidney &amp; renal pelvis</td>
<td>22,330 (3%)</td>
</tr>
<tr>
<td>Oral cavity &amp; pharynx</td>
<td>25,240 (3%)</td>
<td>Ovary</td>
<td>21,550 (3%)</td>
</tr>
<tr>
<td>Pancreas</td>
<td>21,050 (3%)</td>
<td>Pancreas</td>
<td>21,420 (3%)</td>
</tr>
<tr>
<td>All sites</td>
<td>766,130 (100%)</td>
<td>All sites</td>
<td>713,220 (100%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Male</th>
<th>Estimated Deaths</th>
<th>Female</th>
<th>Estimated Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung &amp; bronchus</td>
<td>88,900 (30%)</td>
<td>Breast</td>
<td>70,490 (26%)</td>
</tr>
<tr>
<td>Prostate</td>
<td>27,360 (9%)</td>
<td>Lung &amp; bronchus</td>
<td>40,170 (15%)</td>
</tr>
<tr>
<td>Colon &amp; rectum</td>
<td>25,240 (9%)</td>
<td>Colon &amp; rectum</td>
<td>24,680 (9%)</td>
</tr>
<tr>
<td>Pancreas</td>
<td>18,030 (6%)</td>
<td>Pancreas</td>
<td>17,210 (6%)</td>
</tr>
<tr>
<td>Leukemia</td>
<td>12,590 (4%)</td>
<td>Ovary</td>
<td>14,600 (5%)</td>
</tr>
<tr>
<td>Liver &amp; intrahepatic bile duct</td>
<td>12,090 (4%)</td>
<td>Non-Hodgkin lymphoma</td>
<td>9,670 (4%)</td>
</tr>
<tr>
<td>Thyroid</td>
<td>11,490 (4%)</td>
<td>Leukemia</td>
<td>9,280 (3%)</td>
</tr>
<tr>
<td>Kidney &amp; renal pelvis</td>
<td>10,180 (3%)</td>
<td>Urinary bladder</td>
<td>7,780 (3%)</td>
</tr>
<tr>
<td>Non-Hodgkin lymphoma</td>
<td>9,830 (3%)</td>
<td>Liver &amp; intrahepatic bile duct</td>
<td>6,070 (2%)</td>
</tr>
<tr>
<td>Ovary</td>
<td>9,830 (3%)</td>
<td>Brain &amp; other nervous system</td>
<td>5,590 (2%)</td>
</tr>
<tr>
<td>Pancreas</td>
<td>21,420 (3%)</td>
<td>All sites</td>
<td>269,800 (100%)</td>
</tr>
</tbody>
</table>

*Excludes basal and squamous cell skin cancers and in situ carcinoma except urinary bladder.

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[www.cancer.org](http://www.cancer.org)
## Scope of the Problem

### Probability of Developing Invasive Cancers (%) Over Selected Age Intervals by Sex, US, 2003-2005*

<table>
<thead>
<tr>
<th></th>
<th>Birth to 39</th>
<th>40 to 59</th>
<th>60 to 69</th>
<th>70 and Older</th>
<th>Birth to Death</th>
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</thead>
<tbody>
<tr>
<td><strong>All sites†</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1.42 (1 in 70)</td>
<td>8.44 (1 in 12)</td>
<td>15.71 (1 in 6)</td>
<td>37.74 (1 in 3)</td>
<td>43.89 (1 in 2)</td>
</tr>
<tr>
<td>Female</td>
<td>2.07 (1 in 48)</td>
<td>8.97 (1 in 11)</td>
<td>10.23 (1 in 10)</td>
<td>26.17 (1 in 4)</td>
<td>37.35 (1 in 3)</td>
</tr>
<tr>
<td><strong>Urinary bladder‡</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>0.02 (1 in 4,448)</td>
<td>0.41 (1 in 246)</td>
<td>0.96 (1 in 104)</td>
<td>3.57 (1 in 28)</td>
<td>3.74 (1 in 27)</td>
</tr>
<tr>
<td>Female</td>
<td>0.01 (1 in 10,185)</td>
<td>0.12 (1 in 810)</td>
<td>0.26 (1 in 378)</td>
<td>1.01 (1 in 99)</td>
<td>1.18 (1 in 84)</td>
</tr>
<tr>
<td><strong>Breast</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>0.48 (1 in 208)</td>
<td>3.79 (1 in 26)</td>
<td>3.41 (1 in 29)</td>
<td>6.44 (1 in 16)</td>
<td>12.03 (1 in 8)</td>
</tr>
<tr>
<td><strong>Colon &amp; rectum</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>0.08 (1 in 1,296)</td>
<td>0.92 (1 in 109)</td>
<td>1.55 (1 in 65)</td>
<td>4.63 (1 in 22)</td>
<td>5.51 (1 in 18)</td>
</tr>
<tr>
<td>Female</td>
<td>0.07 (1 in 1,343)</td>
<td>0.72 (1 in 138)</td>
<td>1.10 (1 in 91)</td>
<td>4.16 (1 in 24)</td>
<td>5.10 (1 in 20)</td>
</tr>
<tr>
<td><strong>Leukemia</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>0.16 (1 in 611)</td>
<td>0.22 (1 in 463)</td>
<td>0.35 (1 in 289)</td>
<td>1.17 (1 in 85)</td>
<td>1.50 (1 in 67)</td>
</tr>
<tr>
<td>Female</td>
<td>0.12 (1 in 835)</td>
<td>0.14 (1 in 693)</td>
<td>0.20 (1 in 496)</td>
<td>0.77 (1 in 130)</td>
<td>1.07 (1 in 94)</td>
</tr>
<tr>
<td><strong>Lung &amp; bronchus</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>0.03 (1 in 3,398)</td>
<td>0.99 (1 in 101)</td>
<td>2.43 (1 in 41)</td>
<td>6.70 (1 in 18)</td>
<td>7.78 (1 in 13)</td>
</tr>
<tr>
<td>Female</td>
<td>0.03 (1 in 2,997)</td>
<td>0.81 (1 in 124)</td>
<td>1.78 (1 in 56)</td>
<td>4.70 (1 in 21)</td>
<td>6.22 (1 in 16)</td>
</tr>
<tr>
<td><strong>Melanoma of the skin§</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Male</td>
<td>0.16 (1 in 645)</td>
<td>0.64 (1 in 157)</td>
<td>0.70 (1 in 143)</td>
<td>1.67 (1 in 60)</td>
<td>2.56 (1 in 39)</td>
</tr>
<tr>
<td>Female</td>
<td>0.27 (1 in 370)</td>
<td>0.53 (1 in 189)</td>
<td>0.35 (1 in 282)</td>
<td>0.76 (1 in 131)</td>
<td>1.73 (1 in 58)</td>
</tr>
<tr>
<td><strong>Non-Hodgkin lymphoma</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>0.13 (1 in 763)</td>
<td>0.45 (1 in 225)</td>
<td>0.58 (1 in 171)</td>
<td>1.66 (1 in 60)</td>
<td>2.23 (1 in 45)</td>
</tr>
<tr>
<td>Female</td>
<td>0.08 (1 in 1,191)</td>
<td>0.32 (1 in 316)</td>
<td>0.45 (1 in 223)</td>
<td>1.36 (1 in 73)</td>
<td>1.90 (1 in 53)</td>
</tr>
<tr>
<td><strong>Prostate</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>0.01 (1 in 10,002)</td>
<td>2.43 (1 in 41)</td>
<td>6.42 (1 in 16)</td>
<td>12.49 (1 in 8)</td>
<td>15.78 (1 in 6)</td>
</tr>
<tr>
<td>Female</td>
<td>0.15 (1 in 651)</td>
<td>0.27 (1 in 368)</td>
<td>0.13 (1 in 761)</td>
<td>0.19 (1 in 530)</td>
<td>0.69 (1 in 145)</td>
</tr>
<tr>
<td><strong>Uterine cervix</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>0.07 (1 in 1,499)</td>
<td>0.72 (1 in 140)</td>
<td>0.81 (1 in 123)</td>
<td>1.22 (1 in 82)</td>
<td>2.48 (1 in 40)</td>
</tr>
</tbody>
</table>

*For people free of cancer at beginning of age interval.

† All sites excludes basal and squamous cell skin cancers and in situ cancers except urinary bladder.

‡ Includes invasive and in situ cancer cases.

§ Statistic is for whites only.


American Cancer Society, Surveillance and Health Policy Research, 2009
Tumor Biology

Understanding tumor biology is critical for:
• deciding when to operate
• deciding what operation to do
• deciding when NOT to operate
Classes of Tumors

General Groupings

Carcinoma = Epithelial tumors
- breast, melanoma, GI, GU, lung, GYN, H&N
- invade lymphatic and vascular structures

Sarcoma = Connective tissue tumors
- displace other structures
- hematogenous spread

Ovarian
Testicular

Carcinoid tumors = “carcinoma like”

Liquid tumors – leukemia and lymphoma
What Does it Take to Make a Tumor?

Weinberg, RA. NEJM 2002; 347:1593-1603
Tumor Biology

Normal Epithelium → Hyper-proliferation → Early Adenoma → Intermediate Adenoma → Late Adenoma → Cancer

- APC loss
- K-ras mutation
- Chrom 18 loss
- p53 loss
Staging is All About Real Estate

American Joint Commission on Cancer (AJCC)
T = Tumor (size, grade)  N = Nodes (number)  M = Metastasis

Goals
• Estimate prognosis
• Facilitate treatment planning
• Allow comparisons between treatment groups

General Classification
Stage I - Superficial early cancer
Stage II - Locally advanced - nodes
Stage III - Regionally advanced + nodes
Stage IV - Metastatic beyond regional nodes
Advantages

- Each revision provides more accurate prognosis
- Allows for general estimates of survival

<table>
<thead>
<tr>
<th>Stage</th>
<th>Est 5 yr Survival</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>95%</td>
</tr>
<tr>
<td>II</td>
<td>80%</td>
</tr>
<tr>
<td>III</td>
<td>50%</td>
</tr>
<tr>
<td>IV</td>
<td>5%</td>
</tr>
</tbody>
</table>

Disadvantages

- Each revision more complex
- Stage shifting over time
- Still lumping cancers by relatively crude descriptive characteristics
Cancer Speak

Terms you may have heard

- **Tumor** = abnormal growth
- **Cancer** = tumor that has the capacity to metastasize
- **Adjuvant therapy** = chemo or radiation therapy added after surgery
- **Neoadjuvant therapy** = chemo or radiation therapy given before planned definitive surgery
- **R0** = complete margin negative resection
- **R1** = complete gross resection, microscopically positive margin
- **R2** = gross disease left behind
Biology of Cancer Recurrence
some general rules of thumb

Recurrence of tumor

• Tumor environment is a wound that doesn’t heal
• ~75% of recurrences occur within the first 2 years of surgery
• 5 year mark for “cure” is arbitrary

• One third local recurrence alone
• One third local plus distant simultaneously
• One third distant alone
Statistics for Cancer Patients

- Median follow-up and survival
- Absolute differences vs. relative differences
- Overall survival
- Disease specific survival
- Disease free survival (recurrence free)

Guller U. JACS 2004;198:441-58
Surgery as Curative

• To cure a patient with surgery is still relatively rare
• Some percentage (one third?) may be cured
• Earlier detection is best chance for cure
• Clarify the goal of your operation
  (curative, debulking, palliative, preventative)
Surgery as Preventative

Prophylactic surgery to prevent cancer development

<table>
<thead>
<tr>
<th>Disease</th>
<th>Marker</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAP</td>
<td>APC</td>
<td>Colectomy</td>
</tr>
<tr>
<td>MEN 2</td>
<td>RET</td>
<td>Thyroidectomy</td>
</tr>
<tr>
<td>Familial Breast Cancer</td>
<td>BRCA 1,2</td>
<td>Mastectomy</td>
</tr>
<tr>
<td>Familial Ovarian Cancer</td>
<td>?</td>
<td>Oophorectomy</td>
</tr>
</tbody>
</table>
Principles of Surgery for Local Control

- Local control should be a top priority
- First operation is best chance for control
- Apply basic surgical fundamentals to reduce local recurrences
- Salvage surgery to achieve local control problematic
Principles of Biopsies

To biopsy or not to biopsy that is the question?

Answer:
• Know your tumor biology
• Will it change treatment plan?
• Will biopsy cause tumor spread?
• Biopsy options
  • Aspiration, Core, Incisional, Excisional
• Avoid hematoma
• Plan to excise needle or biopsy site
Principles of Margins

- Factor in tumor biology
- Factor in location
- Factor in other treatments
- In general 1 cm gross margin is minimum necessary
- Wider margin preferable if it can be done with minimal additional morbidity
- Goal of margin is reduced local recurrence
Principles of Lymph Nodes

Function of lymph nodes

- Primarily for antigen recognition
- Not a filter
- Majority of tumor cells pass through
- Rare tumor cells can grow in lymph nodes
- Lymph nodes are indicators - not governors - of survival
Principles of Lymph Nodes

Lymph node dissection

- Harvest lymph nodes for:
  1 staging
  2 local control
  3 interrupt metastatic cascade
- Factor in risk/benefit ratio
Colorectal cancer

- 5 cm margin when possible
- 1 cm margin for low rectal with XRT
- Take major vascular pedicle at origin along with lymph nodes
- Equivalent cancer outcomes from laparoscopic vs. open
Principles of Surgical Oncology

Melanoma

• 1 cm margin for <1mm deep primary
• 2 cm margin for >1mm deep primary
• Exceptions for hands and face
• SLN biopsy for >1mm deep primary
• Sentinel lymph node biopsy for staging
• Lymph node dissection for metastasis
Principles of Surgical Oncology

**Gastric Cancer**

- 5 cm margin when possible
- Take major vascular pedicle with lymph nodes
- Remove lymph node station beyond obviously involved nodes
- Splenectomy generally not indicated
- D2 dissection – no survival benefit
Pancreatic Cancer

- Resectability is in the eye of the beholder
- Contraindications include Celiac, SMA or Hepatic artery involvement
- Relative contraindications include portal vein or lymph node positive disease
Principles of Surgical Oncology

Sarcomas

- 1-2 cm gross margin
- Preserve neurovascular structures
- No need for lymph nodes*
- Radiation reduces local recurrence
- Chemotherapy of limited value
Carcinoids

- Slow growing
- Surgery for symptoms – obstruction, hormonal
- Debulking as a goal
- <1 cm – remove tumor only
- >2 cm – remove tumor and lymph nodes
- 1-2 cm – consider removing lymph nodes
Principles of Surgical Oncology

Liver Tumors

- Primary vs. metastatic
- Resectability
  - Eye of the beholder
  - Real estate
  - Defined by what will be left behind (not by what can be removed)
Principles of Palliative Surgery

- One cannot palliate asymptomatic cancer patients
- Address the highest priority symptom
- Manage expectations
- 25% will fail immediately
- 25% will recur with same symptom
Principles of Radiation Oncology

**Radiation Therapy**

- Rapidly dividing cells
- Can help reduce local recurrence rate
- Organ preservation (breast, larynx, anal sphincter, extremity)
- Technology and targeting improving

Breast cancer
Prostate cancer
Rectal cancer
Head & Neck
Sarcomas
Principles of Medical Oncology

Concepts of Chemotherapy

- Tumor doubling time
- Adjuvant vs. Neoadjuvant
- Targeting molecular pathways
- Biologic response indicators
- Drug development – phase I, II, III
Integrating a Multidisciplinary Approach

Medical Oncology
Pathology
Radiation Oncology
Surgical Oncology
Radiology
Physical Therapy
Nutrition
The paradigm of Gastrointestinal Stromal Tumors (GIST)

- cKIT mutation (tyrosine kinase) identified as the activating growth signal
- Imatinib (Gleevec) developed as an oral agent to block the activating mutation (ATP binding site)
- Indicated in metastatic and high risk resected GIST
- Changed the natural history of this disease

Future of Surgical Oncology
“Targeted Therapy”
Future of Surgical Oncology
“Personalized Therapy”

Example of Tumor KRAS Status in Colorectal Cancer

- Cetuximab (Erbitux) and panitumumab (Vectibix) are monoclonal antibodies directed at the epidermal growth-factor receptor
- Approved for treating metastatic colorectal cancer
- Recent trials demonstrated that tumors with a mutation in KRAS do not respond to EGFR receptor blockade
- Tumor analysis now required to treat with these agents
Biomarkers are tumor or circulating molecules that help detect and monitor certain cancers

- CEA, CA19-9, PSA, CA27-29
- Proteomic analysis
- microRNA or small interfering RNA (siRNA) analysis
- Breath analysis
Occasionally the prince and princess try to overthrow the powerful forces of the King and Queen, sometimes with temporary apparent victories, usually to no long term avail.

Blake Cady, MD
Future of Surgical Oncology

• Growing opportunity
• 1 in 3 diagnosed with some form of cancer
• Aging population
• Increased need for surgical specialists with broad knowledge of cancer treatments
• Integration of multiple therapies
• Field wide open for basic and clinical research
• Intellectually stimulating – rapid progress
• Molecular evaluation of tumor
Rules of Surgical Oncology

Biology is King
Selection is Queen
Technical maneuvers are the Prince and Princess

Occasionally the prince and princess try to overthrow the powerful forces of the King and Queen, sometimes with temporary apparent victories, usually to no long term avail.

Blake Cady, MD
#1 Rule of Surgical Oncology

When in doubt – consult this man
Future of Surgical Oncology

Past
Radical resection

Present
Conservative resection
(laparoscopic approaches)

Future
?
## Tumor Biology

<table>
<thead>
<tr>
<th>Tumor Type</th>
<th>Estimated Tumor Doubling Time (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choriocarcinoma</td>
<td>1.5</td>
</tr>
<tr>
<td>ALL</td>
<td>4-6</td>
</tr>
<tr>
<td>Hodgkin’s</td>
<td>38</td>
</tr>
<tr>
<td>GI adenocarcinoma</td>
<td>80-130</td>
</tr>
</tbody>
</table>

Molecular Events in Pancreatic Cancer

- Oncogene activation/overexpression
  - K-ras (85%)
- Receptor tyrosine kinase overexpression
  - HER2/neu
  - EGFR
- Tumor suppressor mutation
  - p53 (50%)
  - SMAD4 (DPC4) (50%)
- Cell cycle regulatory protein silencing/loss
  - p16 (8%)
- Nuclear Transcription Factor Activation
Scope of the Problem

Estimated number of new cancer cases for 2008, excluding basal and squamous cell skin cancers and in situ carcinomas except urinary bladder.

Note: State estimates are offered as a rough guide and should be interpreted with caution. State estimates may not add to US total due to rounding.
Scope of the Problem


www.cancer.org
Scope of the Problem

Age-Adjusted Cancer Death Rates,* Males by Site, US, 1930–2004

Age-Adjusted Cancer Death Rates,* Females by Site, US, 1930–2004

*Per 100,000, age-adjusted to the 2000 US standard population.
Note: Due to changes in ICD coding, denominator information has changed over time. Rates for cancer of the breast, lung and bronchus, and colon and rectum are affected by these coding changes.
Scope of the Problem


*Age-adjusted to the 2000 US standard population.
Scope of the Problem

2007 Estimated US Cancer Cases*

<table>
<thead>
<tr>
<th></th>
<th>Men 766,860</th>
<th>Women 678,060</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prostate</td>
<td>29%</td>
<td>26%</td>
</tr>
<tr>
<td>Lung &amp; bronchus</td>
<td>15%</td>
<td>15%</td>
</tr>
<tr>
<td>Colon &amp; rectum</td>
<td>10%</td>
<td>11%</td>
</tr>
<tr>
<td>Urinary bladder</td>
<td>7%</td>
<td>6%</td>
</tr>
<tr>
<td>Non-Hodgkin lymphoma</td>
<td>4%</td>
<td>4%</td>
</tr>
<tr>
<td>Melanoma of skin</td>
<td>4%</td>
<td>4%</td>
</tr>
<tr>
<td>Kidney</td>
<td>4%</td>
<td>4%</td>
</tr>
<tr>
<td>Leukemia</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>Oral cavity</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>Pancreas</td>
<td>2%</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.
Scope of the Problem

Cancer Incidence Rates*, All Sites Combined, All Races, 1975-2003

Rate Per 100,000

1 Age-adjusted to the 2000 US standard population and adjusted for delay in reporting.

www.cancer.org
Scope of the Problem

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>All sites</td>
<td>50</td>
<td>53</td>
<td>66</td>
</tr>
<tr>
<td>Breast (female)</td>
<td>75</td>
<td>79</td>
<td>89</td>
</tr>
<tr>
<td>Colon</td>
<td>51</td>
<td>59</td>
<td>65</td>
</tr>
<tr>
<td>Leukemia</td>
<td>35</td>
<td>42</td>
<td>49</td>
</tr>
<tr>
<td>Lung and bronchus</td>
<td>13</td>
<td>13</td>
<td>16</td>
</tr>
<tr>
<td>Melanoma</td>
<td>82</td>
<td>86</td>
<td>92</td>
</tr>
<tr>
<td>Non-Hodgkin lymphoma</td>
<td>48</td>
<td>53</td>
<td>63</td>
</tr>
<tr>
<td>Ovary</td>
<td>37</td>
<td>40</td>
<td>45</td>
</tr>
<tr>
<td>Pancreas</td>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Prostate</td>
<td>69</td>
<td>76</td>
<td>100</td>
</tr>
<tr>
<td>Rectum</td>
<td>49</td>
<td>57</td>
<td>66</td>
</tr>
<tr>
<td>Urinary bladder</td>
<td>73</td>
<td>78</td>
<td>82</td>
</tr>
</tbody>
</table>

*5-year relative survival rates based on follow up of patients through 2003.
†Recent changes in classification of ovarian cancer have affected 1996-2002 survival rates. 
Principles of Patient Selection

• Know tumor biology
• Know extent of disease
• Disease free interval
• Clarify goal of operation
  (cure, debulk, palliate)
Patient Selection - Liver Metastasis

Risk Factors

- Node positive primary
- Disease free interval <12 mo
- >1 tumor
- Size >5cm
- CEA > 200ng/ml

Table 5. CLINICAL RISK SCORE FOR TUMOR RECURRENTNESS

<table>
<thead>
<tr>
<th>Score</th>
<th>1-yr</th>
<th>2-yr</th>
<th>3-yr</th>
<th>4-yr</th>
<th>5-yr</th>
<th>Median (mo)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>93</td>
<td>79</td>
<td>72</td>
<td>60</td>
<td>60</td>
<td>74</td>
</tr>
<tr>
<td>1</td>
<td>91</td>
<td>76</td>
<td>66</td>
<td>54</td>
<td>44</td>
<td>51</td>
</tr>
<tr>
<td>2</td>
<td>89</td>
<td>73</td>
<td>60</td>
<td>51</td>
<td>40</td>
<td>47</td>
</tr>
<tr>
<td>3</td>
<td>86</td>
<td>67</td>
<td>42</td>
<td>25</td>
<td>20</td>
<td>33</td>
</tr>
<tr>
<td>4</td>
<td>70</td>
<td>45</td>
<td>38</td>
<td>29</td>
<td>25</td>
<td>20</td>
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<td>5</td>
<td>71</td>
<td>45</td>
<td>27</td>
<td>14</td>
<td>14</td>
<td>22</td>
</tr>
</tbody>
</table>

Each risk factor is one point: node-positive primary, disease-free interval <12 months, >1 tumor, Size >5 cm, CEA >200 ng/ml.

History of Surgical Oncology
Scope of the Problem

<table>
<thead>
<tr>
<th>Site</th>
<th>Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>All sites†</td>
<td>1 in 3</td>
</tr>
<tr>
<td>Breast</td>
<td>1 in 8</td>
</tr>
<tr>
<td>Lung &amp; bronchus</td>
<td>1 in 16</td>
</tr>
<tr>
<td>Colon &amp; rectum</td>
<td>1 in 19</td>
</tr>
<tr>
<td>Uterine corpus</td>
<td>1 in 40</td>
</tr>
<tr>
<td>Non-Hodgkin lymphoma</td>
<td>1 in 55</td>
</tr>
<tr>
<td>Ovary</td>
<td>1 in 69</td>
</tr>
<tr>
<td>Melanoma</td>
<td>1 in 73</td>
</tr>
<tr>
<td>Pancreas</td>
<td>1 in 79</td>
</tr>
<tr>
<td>Urinary bladder‡</td>
<td>1 in 87</td>
</tr>
<tr>
<td>Uterine cervix</td>
<td>1 in 138</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Site</th>
<th>Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>All sites†</td>
<td>1 in 2</td>
</tr>
<tr>
<td>Prostate</td>
<td>1 in 6</td>
</tr>
<tr>
<td>Lung and bronchus</td>
<td>1 in 12</td>
</tr>
<tr>
<td>Colon and rectum</td>
<td>1 in 17</td>
</tr>
<tr>
<td>Urinary bladder†</td>
<td>1 in 28</td>
</tr>
<tr>
<td>Non-Hodgkin lymphoma</td>
<td>1 in 47</td>
</tr>
<tr>
<td>Melanoma</td>
<td>1 in 49</td>
</tr>
<tr>
<td>Kidney</td>
<td>1 in 61</td>
</tr>
<tr>
<td>Leukemia</td>
<td>1 in 67</td>
</tr>
<tr>
<td>Oral Cavity</td>
<td>1 in 72</td>
</tr>
<tr>
<td>Stomach</td>
<td>1 in 89</td>
</tr>
</tbody>
</table>

* For those free of cancer at beginning of age interval. Based on cancer cases diagnosed during 2001 to 2003.
† All Sites exclude basal and squamous cell skin cancers and in situ cancers except urinary bladder
‡ Includes invasive and in situ cancer cases
### Five-year Relative Survival Rates* (%) by Stage at Diagnosis, 1996-2004

<table>
<thead>
<tr>
<th>Site</th>
<th>All Stages</th>
<th>Local</th>
<th>Regional</th>
<th>Distant</th>
<th>Site</th>
<th>All Stages</th>
<th>Local</th>
<th>Regional</th>
<th>Distant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast (female)</td>
<td>88.7</td>
<td>98.1</td>
<td>83.8</td>
<td>27.1</td>
<td>Ovary</td>
<td>45.5</td>
<td>92.7</td>
<td>71.1</td>
<td>30.6</td>
</tr>
<tr>
<td>Colon &amp; rectum</td>
<td>64.4</td>
<td>89.7</td>
<td>68.4</td>
<td>10.8</td>
<td>Pancreas</td>
<td>5.1</td>
<td>20.0</td>
<td>8.2</td>
<td>1.8</td>
</tr>
<tr>
<td>Esophagus</td>
<td>15.8</td>
<td>34.4</td>
<td>17.1</td>
<td>2.8</td>
<td>Prostate*</td>
<td>98.9</td>
<td>100.0</td>
<td>—</td>
<td>31.7</td>
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<tr>
<td>Kidney*</td>
<td>66.5</td>
<td>89.9</td>
<td>61.3</td>
<td>9.9</td>
<td>Stomach</td>
<td>24.7</td>
<td>60.7</td>
<td>24.8</td>
<td>3.7</td>
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<tr>
<td>Larynx</td>
<td>62.5</td>
<td>80.9</td>
<td>50.2</td>
<td>23.4</td>
<td>Testis</td>
<td>95.5</td>
<td>99.3</td>
<td>95.7</td>
<td>71.1</td>
</tr>
<tr>
<td>Liver*</td>
<td>11.7</td>
<td>23.8</td>
<td>7.7</td>
<td>2.9</td>
<td>Thyroid</td>
<td>96.9</td>
<td>99.7</td>
<td>96.9</td>
<td>57.8</td>
</tr>
<tr>
<td>Lung &amp; bronchus</td>
<td>15.2</td>
<td>49.5</td>
<td>20.6</td>
<td>2.8</td>
<td>Urinary bladder</td>
<td>79.8</td>
<td>92.5</td>
<td>44.7</td>
<td>6.1</td>
</tr>
<tr>
<td>Melanoma of the skin</td>
<td>91.2</td>
<td>98.7</td>
<td>65.1</td>
<td>15.5</td>
<td>Uterine cervix</td>
<td>71.2</td>
<td>91.7</td>
<td>55.9</td>
<td>16.6</td>
</tr>
<tr>
<td>Oral cavity &amp; pharynx</td>
<td>59.7</td>
<td>82.2</td>
<td>52.7</td>
<td>28.4</td>
<td>Uterine corpus</td>
<td>82.9</td>
<td>95.5</td>
<td>67.5</td>
<td>23.6</td>
</tr>
</tbody>
</table>

* Rates are adjusted for normal life expectancy and are based on cases diagnosed in the SEER 17 areas from 1996-2004, followed through 2005.
† Includes renal pelvis. ‡ Includes intrahepatic bile duct. § The rate for local stage represents local and regional stages combined.

**Local:** an invasive malignant cancer confined entirely to the organ of origin. **Regional:** a malignant cancer that 1) has extended beyond the limits of the organ of origin directly into surrounding organs or tissues; 2) involves regional lymph nodes by way of lymphatic system; or 3) has both regional extension and involvement of regional lymph nodes. **Distant:** a malignant cancer that has spread to parts of the body remote from the primary tumor either by direct extension or by discontinuous metastasis to distant organs, tissues, or via the lymphatic system to distant lymph nodes.


American Cancer Society, Surveillance and Health Policy Research, 2009
Imaging of Cancer Patients

Pre-op Imaging
• Apply tumor biology principles
• What would change the type or timing your operation?

Post-op Imaging
• Selective
• Patient anxiety
• Salvage surgery for recurrence is rare
• No prospective trial for “routine” post-op testing has shown a benefit in survival