Brain Cancer: Statistics and Cluster Investigations

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Understanding Cancer

- All cells are programmed to follow a natural life cycle called the **cell cycle**.

- Cancer arises from changes in the cell’s DNA controlling the cell cycle.
  - Cell loses ability to control its growth

- DNA can be damaged through a variety of exposures:
  - Genetics, Infections, Drug or Tobacco Use, Chemical Exposure, Radiation Exposure…
The Brain

Frontal lobe

Parietal lobe

Occipital lobe

Cerebellum

Spinal cord

Left hemisphere

Cerebrum

Temporal lobe

Brain stem

Neuroglial Cells

Nuerons

Capillary

Oligodendrocyte

Astrocyte

Ependymal cell

Axon

Microglial cell

 Fluid-filled cavity of the brain or spinal cord
General Brain Cancer Statistics

- 190,000 people diagnosed with brain cancer each year in the US.
  - US: 40,000 primary site tumors per year (11/100,000 persons)
  - Illinois: 773 brain/nervous system tumors per year (7/100,000 persons)
  - 60050 Zip Code: 3 brain/nervous system tumors per year (2/100,000 persons)

- Average age of diagnosis:
  - Adults: 54 years old
  - Children: Distributed evenly between 0 and 19 years old

- Trends in age vary depending on type and location of tumor.

- Certain cancers are found more commonly among a specific gender.
5-Year Incidence Rates of Brain/Nervous System Cancers (per 100,000 population) in McHenry County and Illinois from 1998-2003

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>McHenry County</td>
<td>7.7</td>
<td>6.9</td>
<td>9.9</td>
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<tr>
<td>Illinois</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>4.9</td>
<td>6.8</td>
<td>6.0</td>
</tr>
<tr>
<td>Total</td>
<td>6.3</td>
<td>6.9</td>
<td>8.0</td>
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<tr>
<td>Male</td>
<td>7.5</td>
<td>7.8</td>
<td>7.4</td>
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<tr>
<td>Illinois</td>
<td>5.2</td>
<td>5.2</td>
<td>5.4</td>
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<tr>
<td>Female</td>
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<td></td>
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</tr>
<tr>
<td>Total</td>
<td>6.4</td>
<td>6.5</td>
<td>6.4</td>
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</tbody>
</table>
## Leading Cancer Sites Among McHenry County Males and Females (1999-2003)

<table>
<thead>
<tr>
<th>All Genders</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Breast (17.5%)</td>
<td>1. Prostate (26.8%)</td>
<td>1. Breast (34.5%)</td>
</tr>
<tr>
<td>2. Prostate (13.3%)</td>
<td>2. Lung &amp; Bronchus (26.5%)</td>
<td>2. Lung &amp; Bronchus (12.2%)</td>
</tr>
<tr>
<td>3. Lung &amp; Bronchus (13.2%)</td>
<td>3. Colon &amp; Rectum (22.4%)</td>
<td>3. Colon &amp; Rectum (10.2%)</td>
</tr>
<tr>
<td>4. Colon &amp; Rectum (11.2%)</td>
<td>4. Bladder (7.2%)</td>
<td>4. Corpus &amp; Uterus (5.7%)</td>
</tr>
<tr>
<td>5. Bladder (4.8%)</td>
<td>5. Skin Melanoma (4.6%)</td>
<td>5. Non-Hodgkin’s Lymphoma (3.8%)</td>
</tr>
<tr>
<td>6. Non-Hodgkin’s Lymphoma (4.2%)</td>
<td>Non-Hodgkin’s Lymphoma (4.6%)</td>
<td>6. Skin Melanoma (3.4%)</td>
</tr>
<tr>
<td>7. Skin Melanoma (4.0%)</td>
<td>7. Kidney (3.8%)</td>
<td>7. Ovary (3.0%)</td>
</tr>
<tr>
<td>8. Kidney (3.0%)</td>
<td>8. Oral &amp; Esophagus (3.3%)</td>
<td>8. Bladder (2.5%)</td>
</tr>
<tr>
<td>9. Corpus &amp; Uterus (2.9%)</td>
<td>9. Pancreas (2.2%)</td>
<td>9. Cervix (2.2%)</td>
</tr>
<tr>
<td>10. Leukemia (2.5%)</td>
<td>Brain &amp; Nervous System (2.2%)</td>
<td>Kidney (2.2%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12. Brain and Nervous System (2.2%)</td>
</tr>
</tbody>
</table>
Percent of All Cancers that are Brain or Nervous System Cancers Diagnosed in McHenry County and Illinois Utilizing 5-Year Incidence Rates from 1989-2003

<table>
<thead>
<tr>
<th>Year/Region</th>
<th>Total</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>McHenry County</td>
<td>1.5%</td>
<td>1.6%</td>
<td>1.8%</td>
</tr>
<tr>
<td>1989-1993</td>
<td>1.9%</td>
<td>1.6%</td>
<td>2.2%</td>
</tr>
<tr>
<td>1994-1998</td>
<td>1.6%</td>
<td>1.4%</td>
<td>1.4%</td>
</tr>
<tr>
<td>1999-2003</td>
<td>1.5%</td>
<td>1.5%</td>
<td>1.4%</td>
</tr>
<tr>
<td>Illinois</td>
<td>1.3%</td>
<td>1.2%</td>
<td>1.2%</td>
</tr>
</tbody>
</table>
There are over 120 types of brain tumors!

Locations of common primary site brain tumors
BRAIN CANCERS

Primary Site
Brain Tumors

Glial Tumors (Gliomas)
(49% of all primary brain tumors)

- Brain Stem Glioma
- Ependymoma
- Mixed Glioma
- Oligodendroglioma (3-4% of all brain tumors)
- Optic Nerve Glioma
- Astrocytoma

Secondary (Metastatic) Brain Tumors
(Most Common Types of Tumors)

- Pituitary Tumor
- Chordoma
- Non-Glial Tumors
- Pineal Tumor (Several types)
- Medulloblastoma
- CNS Lymphoma
- Acoustic Neuroma (schwannoma)
- Craniopharyngioma
- Hemangioblastoma
- Meningioma

- Grade 1: Pilocytic Astrocytoma
- Grade 2: Low-Grade Astrocytoma
- Grade 3: Anaplastic Astrocytoma
- Grade 4: Glioblastoma Multiforme (23% of all brain tumors)
- Grade 1: Benign Meningioma
- Grade 2: Atypical Meningioma
- Grade 3: Malignant (anaplastic) Meningioma
Astrocytoma

- A form of Glioma
- Located anywhere in the brain, but most commonly in the frontal lobe.
- Most common primary site brain tumor.
- 4 Different classifications depending on how fast the cancer cells grow.
  - Grade I: Pilocytic Astrocytoma
  - Grade II: Low-Grade Astrocytoma
  - Grade III: Anaplastic Astrocytoma
  - Grade IV: Glioblastoma Multiforme (GBM)
Astrocytoma (continued)

- The symptoms, gender and age group affected depends on the astrocytoma grade and location.
  - Example:
    - Pilocytic astrocytoma: Children and Teens
      - 2% of all brain tumors
    - Glioblastoma Multiforme: 50 – 70 year olds
      - More common in males
      - 23% of all brain tumors
Oligodendroglioma

- A form of glioma
- Low to High Grade
- Commonly among men and women in their 20s – 40s, but can occur in children.
- More common in men than women.
- Accounts for slightly less than 3% of all brain tumors.
- Associated with 1p or 19q chromosomal losses.
Incidence and Mortality

Primary site brain tumors are among the top 10 causes of cancer related deaths.

Nearly 13,000 people die in the US each year from primary site brain tumors.

Factors affecting survival:
- Race and Ethnicity
- Age
- Tumor Type
- Location
- Treatment Options
- Functional Status
Known and Possible Causes

- Only proven causes of brain tumors:
  - Rare hereditary syndromes
  - Therapeutic radiation
  - Immunosuppression
- Account for only a very small amount of cases
- Little agreement about the nature and extent of the risk factor
Known and Possible Causes (continued)

- Heredity
- Viruses
- Ionizing Radiation
- Diet (n-nitroso compounds)
- Air Pollution
- Cell Phones?
Chemicals

- Gathering evidence is difficult
  - Workers rarely exposed to one single chemical
  - Certain chemicals probably work together to increase or decrease risk

- SOME evidence that workers in the production of synthetic rubber, PVC and petrochemicals are at greater risk for developing brain tumors.

- Potential for parents exposed in the workplace may increase the risk of cancer in their children.
Cancer Cluster Investigations

- Objectives:
  - Verify that a cancer cluster truly exists
  - Determine if human exposure to a possible environmental hazard actually exists
  - Resolve if the relationship between these two merit further investigation and/or action.
How Would we Know if There is a True “Cancer Cluster?”

- A “Biologically-Plausible” explanation is discovered
  - Usually through environmental inspection
- There is a significant increase in ONE type of cancer among residents.
  - Must be a geographically defined area
  - Must occur in residents with the same exposure periods.
- Residents must be exposed to the possible agent through the same mechanism.
Why are Cancer Clusters Difficult to Investigate?

- Potential clusters of disease are usually too small to perform a useful epidemiological study.
- Reported clusters often have vague definitions of disease.
- The “Texas Sharpshooter” fallacy.
- Exposures are often poorly characterized, mixed together and are low in concentration.
- Potential clusters often create publicity making unbiased data collection impossible.
60050 Zip Code

- Includes the following locations:
  - Bull Valley (portions)
  - Holiday Hills (portions)
  - Johnsburg (portions)
  - Lakemoor (portions)
  - McCullom Lake
  - McHenry (portions)
60050 Zip Code Analysis

- Environmental analysis does not support evidence of a cancer cluster.
- Several different forms of cancer were reported in the population by the media.
- No significant increase in the incidence of cancer in the 60050 zip code compared to the incidence of cancers in McHenry County.
- No significant increase in the incidence of total brain cancer/nervous system cancers in the 60050 zip code compared to the incidence of brain cancers in McHenry County.