# Metro Region Cancer Program

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Our central nervous system is comprised of the brain and spinal cord. The brain is the center of thought, memory, emotion and speech, while the spinal cord and cranial nerves carry messages between the brain and the rest of the body. Is it any wonder that the thought of a tumor in any part of the central nervous system elicits more emotion among patients and physicians than any other cancer site? Although relatively few in number (about 1.3% of all cancers), tumors in the central nervous system are rarely non-cancerous.

Aurora Health Care has recognized both the emotional power and the relatively low 5-year survival rates of these cancers and has organized a collaborative team of experts and provided them with advanced technology to address the complexity of these cancers. From medical and surgical interventions to the non-invasive Gamma Knife and comforting psychotherapy, the techniques and treatments contained within this report discuss the breadth of the topic.

An important part of our cancer program is education, both to patients and providers. We trust that the provider reading this report will find something that assists them either in caring for their patients or providing a referral. We also trust that our annual report gives the patient or family member who reads it something equally important – a reason for believing that a team of experts at Aurora is dedicating their professional lives to the prevention, diagnosis and treatment of cancer, whether it be located in the central nervous system or anywhere else.
It is hard to believe another year has come and gone. It has been an exciting year. On September 25, 2001, the Second Annual Men's Health Conference took place at the Four Points Sheraton in South Milwaukee. Harry Belafonte, a prostate cancer survivor, was the keynote speaker. Also, Mark Samuelson of the Center for Disease Control spoke about being proactive in one's health. Both speakers were excellent and were well received by the 800 people who attended the event. Other health care issues were also addressed including hypertension, glaucoma, diabetes mellitus, coronary artery disease, stroke prevention and colon cancer. I would like to thank the many physicians who were on hand to answer questions. This year the Buddies Against Prostate Cancer, Bob Reitman, Gary Gruneau and Ken Sanders, sponsored their annual golf outing. The monies raised by the event helps support the Men's Health Conference and prostate cancer awareness. I would like to thank them and everyone who helped make this year's event a tremendous success.

Several new exciting developments have taken place at St. Luke's Medical Center this year. St. Luke's was chosen as one of 50 facilities in the nation to be licensed by the Nuclear Regulatory Commission to utilize vascular brachytherapy to treat coronary arterial disease. The first case was done in March 2001. We have now done over 90 cases and are quite excited about its ability to reduce coronary artery re-stenosis. Also, intensity modulated radiation therapy (IMRT) will be available at the end of 2001. This is effective in treating previously radiated cancers and the treatment of tumors in the proximity of delicate organs such as the eyes and spinal cord. The IMRT is utilized to treat primary metastatic brain tumors, pancreatic tumors, liver tumors, prostate cancer, head and neck tumors and lung cancer.

St. Luke's is now providing positive emission tomography (PET scanning). This technology is useful in diagnosis and staging certain types of oncologic cancers. It is specifically used to help distinguish solitary pulmonary nodules, small cell carcinoma of the lung, recurrent colorectal cancer, lymphoma, melanoma, brain tumors, head and neck carcinoma and breast cancer.
The Gamma Knife continues to be an excellent tool for treating delicate brain tumors. It precludes the need for open brain surgery and/or hospitalization. These patients are treated as outpatients and continue to do well.

The community outreach activities that have taken place throughout the year can be found in the Community Outreach Activities portion of the annual report. Again, the Vince Lombardi Golf Outing and Vince Lombardi Award Dinner Ball were a great success. I would like to thank all the volunteers for their continued support and generosity for the Vince Lombardi Cancer Clinic and programs. The breast cancer “Race for the Cure” took place on October 21, 2001. The monies raised from the event go to breast cancer research and grants throughout the Milwaukee area. On September 7 and 14, 2001 the Girl Scouts had an event that over 1,500 girls attended to earn a patch developed to increase breast cancer awareness.

Finally, I would like to personally thank the members of the cancer committee for their hard work and dedication throughout the year. I would specifically like to thank Patty Abella, Bill Laffey, Lisa Robinson, Marija Weidman and Phil Whitton. They have made the Cancer Committee as well as cancer services throughout the state and the metro area a great success.
The Cancer Program at Sinai Samaritan Medical Center, now Aurora Sinai Medical Center (ASMC) as of October 15, 2001, continues to concentrate on programs of service, education and research.

The Committee added several new members this year to expand its multidisciplinary focus into all phases of oncologic activity.

The oncology program at ASMC has new visibility on a national level through participation in the ACOS Commission on Cancer's (CoC) National Cancer Data Base. With our consent, the CoC supplies data about our cancer program to the American Cancer Society's National Information Center (NIC). The NIC makes this information available to the public. Information includes the services available at ASMC, the number of cancers treated each year and their stages. The NIC is available by phone (1-800-ACS-2345) or the Internet (www.cancer.org).

We were pleased to see thought given to a geriatric oncology program at our institution and noted continued activity of the Lung Cancer Task Force. Lung cancer is second only to breast cancer in frequency at ASMC and is still the most frequent cause of cancer deaths nationally among men and women. Paradoxically, it is the most preventable cancer, but the obstructions to progress are many. The Breast Health Center expanded its services, adding prosthesis supply and fitting. The safety of our patients remains a top priority. Our pharmacy made cancer therapy even safer at ASMC with innovative policies related to prescription writing and to ordering and administration of systemic cancer therapy.

Research continues on several fronts. Recruitment for the National STAR Breast Cancer Prevention Trial has passed the halfway mark. Participation locally, which is coordinated at ASMC, now totals 76 women. We are also on the forefront of research in axillary sentinel node biopsy (SLNB) which is an important advancement in the treatment of women with breast cancer. SLNB makes axillary dissection...
unnecessary for the majority of patients, reducing the potential morbidity of treatment. Participation in ECOG protocols of adjuvant and palliative therapy continues to offer the latest forms of treatment to patients with many forms of cancer. For men, a prostate cancer screening program (SELECT) is in place under the direction of Gary Shapiro, MD. Prostate cancer is the most frequent incident cancer among men and can be detected at an early stage with digital examination and testing for prostate specific antigen. Harry Belafonte spoke this year at Aurora's Second Annual Men's Health Conference to promote prostate cancer screening. This famous entertainer is an international figure in the effort against prostate cancer through screening and appropriate treatment.

I wish to applaud those responsible for the continuing success of our weekly tumor conference. This conference is a popular forum for clinical oncologists in multiple disciplines, and has an important educational function. We welcomed the new digital projection equipment for slides and x-rays that was made available by funds from the ASMC Continuing Medical Education Committee. Now x-rays can truly be seen from the back of the room.

The large number of cases of breast cancer seeking treatment at ASMC stimulated plans for a regular working breast conference as a source of consultation, treatment planning and information exchange.

Progress and opportunities continue to rise before us. We look forward to closer connections with other Aurora centers through video conferencing, and to what is expected eventually to be a closely coordinated metro oncology program with an integrated data system.

This year's Metro annual report focuses on brain cancer, an infrequent but devastating form of the disease. Fortunately, new technology is providing improved treatment. Again this year, I would like to thank the members of the Cancer Committee for their dedication and hard work and welcome the new Cancer Committee members who are so important to the continuing vitality of our cancer program.
Over the past year, many changes have taken place at West Allis Memorial Hospital. The most appreciable change has been the construction of the Aurora Women's Pavilion. Consistent with our commitment to providing the most comprehensive services to our community, the Aurora Women's Pavilion offers global care to women focusing on all of the stages of their lives. Not only will it provide complete medical services such as primary care, obstetrics and gynecology, cancer care and programs pertinent to midlife transition, but also it will provide programs in education, lifestyle, fitness and complementary medicine.

With the new addition, the Radiation Oncology suite will shift to the Aurora Women's Pavilion. State-of-the-art equipment will allow us to continue to take advantage of technological advances so that patients will have access to the latest treatments in cancer care, such as 3-D conformal external beam radiation therapy and IMRT — intensity modulated radiation therapy.

Cancer Committee members remain active in the education component of cancer services with weekly cancer conferences, Grand Rounds and annual seminars. Members continue to actively participate in the American College of Surgeons Oncology Group National trials, RTOG protocols and other such national cooperative group studies. The members have been committed to the community through lectures, participation in community events and by volunteering their time at Aurora’s Second Annual Men’s Health conference. Coupled with the integration of the cancer services throughout the Metro Region, we have been able to provide the latest in cancer care to our patients.

It has been an honor and a privilege to chair the Cancer Committee at West Allis Memorial Hospital. I would like to thank each and every member who has contributed to the program. Because of these efforts, the cancer program has remained very successful in providing the highest quality of care.
While Hartford Memorial Hospital’s name has changed to Aurora Medical Center in Hartford, our commitment to cancer care excellence has not changed. The Cancer Committee has grown over the past year since its inception. We are fortunate to have as members individuals dedicated to the enhancement of the quality of patient care in Washington County.

Due to both the enthusiasm of these professionals, as well as our connection with the resources of Aurora Health Care, county residents now have local access to services such as the Cancer Counseling Center, the only one of its kind in Wisconsin, and one of very few in the country. Area physicians are able to make referrals for patients whose treatment calls for brachytherapy or who may require PET scanning for treatment planning. The breast health program at the Aurora Medical Center is coordinated by a nursing professional specializing in this field.

Our integration of cancer committee meetings with tumor boards has allowed for better professional discussion of interesting or challenging cases. Collaboration with physicians at St. Joseph’s Hospital in West Bend has increased the educational value of these conferences. Our physicians also have increased participation in national cooperative group studies to improve access to the latest diagnostic and treatment options for their oncology patients.

As always, our community continues to support local events such as Relay for Life, lectures and other programs which address the important areas of education, prevention, and early diagnosis. Our ability to provide support groups to patients and families is further evidence of the professionalism and dedication of our providers and volunteers.

Once again, let me express collective appreciation from all who participate in the Aurora Medical Center’s Cancer Committee and Tumor Boards to those who not only make our jobs easier, but who impact our patients’ health status in so many positive ways.
tracking cancer incidence, treatment and outcome is one of the most important fights in the war against cancer. It is through quality data that caregivers and researchers strive to increase survival trends by utilizing the most efficient treatment methods to improve and eventually eliminate the morbidity and mortality caused by cancer. According to the annual report of the National Cancer Institute, the rate of new cancer cases and deaths from all cancer cases combined has declined over the last 10 years, despite the increasing size of the American population. From this we can draw the conclusion that information is the backbone of new knowledge and technologies.

Aurora Health Care’s Metro Region encourages hospitals and clinics to collect and report cancer data to the National Cancer Data Base and the Wisconsin Cancer Reporting System which in turn reports information to the North American Association of Central Cancer Registries, the Centers for Disease Control, including the National Center for Health Statistics.

For the year 2000, the Clinical Data Registrars accessioned over 3,138 new cancer cases within the Metro Region of Aurora Health Care. St. Luke’s Medical Center, the largest hospital in the region, saw 2,070 cases, of which 1,830 were analytical. West Allis Memorial Hospital’s cases grew to 608, of which 559 were analytical. Aurora Sinai Medical Center accessioned 348 cases, of which 319 were analytical. Aurora Medical Center in Hartford saw 112 new cancer cases, of which 79 were analytical.

In addition to collecting and following cancer cases for the approved cancer registries of the hospitals in the Metro Region, the registrars were instrumental in bringing the larger ambulatory clinics (Wilkinson Medical Centers and Washington County Aurora Health Centers) current in cancer reporting to the State of Wisconsin. Additional activities in which the registrars were involved included coordinating the majority of the tumor board and breast cancer conferences at each of the hospitals, participating in the ad hoc data collection of the ACOS patient care evaluation studies of the brain and the liver, assuring physician review of 10% of the...
analytical abstracted cases, and submitting reports and data for over 31 requests to hospital administrators, marketing managers and physicians.

To stay abreast of the ever changing rules and regulations in the registry setting, the registrars participated in a number of continuing education events including the 27th Annual National Cancer Registrar’s Association (NCRA) meeting, the NCRA hosted a satellite teleconference on the new International Classification of Diseases for Oncology Coding 3rd Edition, and the 33rd Annual Southeastern Wisconsin Cancer Conference. In addition, Aurora registrars hosted and coordinated the Wisconsin Cancer Registrars Association’s (WCRA) 2001 Spring Conference at Aurora Sinai Medical Center and arranged the fall WCRA Annual meeting. Congratulations go out to our registrar Mary Kissinger, RHIA, CTR who serves as President and immediate past president of WCRA.

Within this year’s annual report is an in-depth collaboration of brain/CNS tumor data, incorporating data from the National Cancer Database’s 2000 Patient Care Evaluation study, in which both benign and malignant brain tumors were reviewed. The data displayed as Aurora Health Care Metro Region (AHC-Metro) is information combined from St. Luke’s Medical Center, Aurora Sinai Medical Center and West Allis Memorial Hospital. This compilation of data is compared to the Central Brain Tumor Registry of the United States (CBTRUS). The CBTRUS, was established in 1992 and provides the largest aggregation of population-based data on all primary brain/CNS tumors in the United States. Currently, fourteen states participate in the CBTRUS; Wisconsin does not. The CBTRUS is a not-for-profit corporation committed to providing a resource for gathering and disseminating data on all primary brain tumors, benign and malignant. Before the CBTRUS was established, reporting in the U.S. was limited to only malignant brain tumors. However, research has proven that benign tumors often impose the same costs to society in terms of medical care, care fatality and lost productivity. Also, it has become clear that certain benign brain tumors may become malignant over time. Thanks go out to Sheri Hackbarth, RHIA for benchmarking the brain statistics, and to the following registrars for their dedication in providing accurate and timely oncology data collection and follow-up.

**Cancer Registrars**
Sharon Collison, RHIT, CTR
Deborah Dries, RHIT, CTR
Judith Ferkans, RHIT
Cynthia Ganzel, RN, RHIT, CTR
Sheri Hackbarth, RHIA
Jamie Keen
Mary Kissinger, RHIA, CTR
Tracy Miller
Patricia Norris, RHIT
Karen Pollock
Marilyn Raciti, RHIA, CPHQ
Jacqueline Schramm, RHIT
Jane Seymour, RHIT, CTR
In Depth Articles
special focus on brain tumors
Perhaps, there is no more distressing diagnosis for patients and physicians alike than that of a brain tumor. Unlike tumors in other locations, the clinical course of central nervous system (CNS) tumors is not only dependent on tissue histology but also on their anatomic location. A histologically benign tumor located in a critical area can have as much of a devastating effect as a pathologically highly malignant neoplasm.

The epidemiological study of brain tumors is frequently limited by the lack of histologic confirmation of the diagnosis. Without adequate pathology review, tumors are likely to be misclassified. Tumor location may preclude obtaining tissue diagnosis, making it impossible to determine if the tumor is primary or metastatic, benign or malignant. Small tissue samples obtained through a stereotactic biopsy or limited resections introduce sampling errors. Even when sufficient tissue is available, a conclusive diagnosis sometimes cannot be established. Epidemiologic study has also been influenced by the histologic variety of CNS tumors and the varying nomenclatures and classifications that have been used in different parts of the world and at different times.

About 9% of all primary neoplasms originate in the CNS and its coverings. After a peak incidence in childhood, they decrease between the ages of 15 and 25, only to increase exponentially from age 25 to 70. Brain tumors are twice as common in men as in women, and the second most common malignancy in childhood. Twenty percent are secondary malignancies. Just as they differ by sex and age, CNS tumors vary by country, ethnic group, and also over time. Mortality rates from brain tumors in the United States are about 6/100,000/year. When one takes a global perspective, this number is as high as 10/100,000/year in Scandinavia and as low as 4/100,000/year in Japan. Because all these countries have similar, highly developed medical systems, race may be responsible for the difference. There appears to have been an increased incidence in these tumors over the last 100 years. This may be due to the development of better diagnostic imaging techniques, improved standard of living with a greater access to specialized medical care, and a longer living population.

Although genetic and environmental influences, including radiation, chemical carcinogens and viruses, have been implicated as causative agents,
their etiology remains largely unknown. Retinoblastoma and chemodectoma are examples of tumors with a clearly established familial incidence. Brain tumors are also frequent in association with other hereditary disorders, such as neurofibromatosis. The association between primary brain tumors and primary tumors in other sites, such as meningiomas and breast cancer or retinoblastomas and osteosarcomas, also suggests a genetic link.

There is increasing evidence that exposure to diagnostic or therapeutic ionizing radiation may increase tumor risk, although atomic bomb survivor data show that the risk is only marginal. Several studies have revealed an increased brain tumor incidence in children who were treated with low dose radiation for tinea capitis. Radiation-induced atypical meningiomas are a well-known late complication of external beam radiation treatment. Dental x-rays also have been associated with an increased risk of meningiomas, especially in women. The role of non-ionizing radiation as an etiologic factor for brain tumors remains controversial. Studies on the effects of electromagnetic fields from power lines, computer monitors and the like, remain inconclusive.

Exposure to benzene and other organic solvents, aromatic hydrocarbons, vinyl chloride, phenol, lubricating oils and other chemicals, has been associated with a greater risk for developing a CNS tumor. A higher incidence of brain tumors has been shown in occupations that involve contact with chemicals encountered in oil refining, pharmaceutical and chemical industries, airplane and electronics manufacturing, and farming. Some of these chemicals have also been successfully used to induce neoplasms in laboratory animals. Interestingly, an increased risk has also been suggested for mathematicians and clergymen.

RNA and DNA viruses have been implicated in the development of brain tumors and of recent, evidence is accumulating that they may be a factor in CNS carcinogenesis. A variety of tumors have been induced in laboratory animals using the Rous Sarcoma Virus, SV 40, JC papovavirus and others. C-type viruses and DNA from the BK virus, a human papovavirus, have been detected in human CNS neoplasms. Also, a single case of a high-grade astrocytoma in a patient with progressive multifocal leukoencephalopathy due to infection with the JC virus has been reported.

Other factors, such as alcohol consumption, tobacco abuse, the use of drugs (particularly anticonvulsants) and even noise have been linked with a heightened risk for CNS tumors, but the findings are difficult to interpret and a direct association does not exist. Although much is known, the epidemiology of brain tumors remains poorly understood. The combined results of studies carried out during the last 20 years, and others in progress, as well as the introduction in epidemiologic studies of molecular biology and molecular pathology will do much to identify the chemical and biologic agents responsible for the development of CNS tumors and open a door for their prevention and cure.
Per the Central Brain Tumor Registry of the United States (CBTRUS) the incidence of all primary (benign and malignant) brain and CNS tumors is higher in males than in females, based on the 2000 US Standard Population Rate. In comparing the distribution by sex among Aurora Health Care's Metro Region and the CBTRUS, the occurrence rate in males is exactly the same as seen at the national level with 52% being male and 48% being female.

Per the CBTRUS the mean age of diagnosis for all primary brain tumors is 54. The incidence of Glioblastoma Multiforme (GBM) and meningiomas increases with age. The incidence for all brain tumors is highest among the 75-84 year olds. However, the different histologies have different age distributions.

Here at AHC-Metro 81% of our brain/CNS tumor incidence occurred from age 45 and older with the highest concentration in the 55-74 age range. In general Aurora's Metro Region saw younger patients than were reported through the CBTRUS.

When comparing the World Health Organization (WHO) Histology Groupings of brain and central nervous system tumors reported by the CBTRUS to Aurora Health Care's Metro Region (AHC-Metro), you will find AHC-Metro saw a larger percentage of tumors of the meninges (33% vs. 27%), cranial/spinal nerves (22% vs. 7%) and lymphomas (4% vs. 3%) and saw a fewer number of those tumors of the neuroepithelial tissue (30% vs. 47%) than those reported for the CBTRUS. This disparity may be attributed to AHC being the first facility in the State of Wisconsin to offer the Gamma Knife procedure to patients who suffer from tumors of the meninges and tumors of the nerve sheath.
The imaging of brain tumors continues to improve, with newer techniques and more sensitive equipment having been developed over the past several decades. Common diagnostic tools include CT (computed tomography), MRI (magnetic resonance imaging), and more recently magnetic resonance spectroscopy (MRS) techniques. PET (positive emission tomography) scanning has remained of somewhat limited use in brain imaging.

The radiological evaluation of brain tumors usually consists of CT and MRI. CT is usually the first study ordered and can reveal an unsuspected brain tumor in a patient with headaches, for example. Depending on the age, location, and appearance of the tumor, some information can be gained regarding possible etiology. However, most tumors ultimately deserve MRI evaluation with intravenous contrast administration.

MRI is the most sensitive test available to detect and characterize brain tumors. Less aggressive primary brain tumors, or gliomas, usually are well defined on MRI, and demonstrate little if any enhancement. More aggressive gliomas are usually of heterogeneous signal intensity on MRI with irregular borders. These tumors demonstrate more pronounced enhancement (Figure 1A & 1B). Brain metastases typically densely enhance after contrast administration (Figure 2) and are multiple. Unfortunately, MRI is not specific in predicting the histology of brain tumors and cannot reliably estimate the grade of tumors.

More recently, MR spectroscopy has been utilized in the evaluation of brain tumors. This technique involves the analysis of chemicals that are involved in body metabolism, and more specifically, in how metabolic heterogeneity can be measured in brain tumors (1A). Brain tumors usually have an abnormal spectral analysis with an increased choline and phosphonomonester level and a decreased NAA (N-acetyl aspartate) level. An alkaline pH is also commonly seen in association with high lactate levels. MRS patterns can be analyzed before, during, and after chemotherapy or radiation therapy to assess for interval changes/responses to treatment. For example, increasing choline levels over time is a worrisome sign for malignant degeneration. A decrease in choline levels suggests improvement. Choline is also decreased in chronic radiation necrosis. There is no general agreement about the ability of MRS to accurately gauge high-grade vs. low-grade tumors.
PET scanning has had a somewhat limited role to date in the workup of most brain tumors. In general, larger series have demonstrated that more aggressive brain metastases usually have higher uptake of FDG (2-{18F}-fluoro-2-deoxy-d-glucose) than less aggressive tumors (2). A poorer prognosis can be expected in patients with elevated FDG uptake in a brain tumor. This too can be studied following therapy; absent FDG uptake would suggest necrosis after therapy, whereas FDG uptake into an enhancing mass suggests viable tumor remains. The limitation of FDG is in detecting low and some intermediate grade tumors.

The future of radiology tumor imaging looks promising, especially with advances in functional MRI and MR spectroscopy. Tumor specific agents may offer additional promise, as well as combined CT/PET imaging.
Not long ago, it was almost unimaginable: a surgical treatment for brain tumors that did not involve a conventional incision, thus eliminating bleeding and greatly reducing the risk of post-operative infection. A procedure performed under a local intravenous anesthesia, with discharge the same day or the next day. But all that is commonplace today with Gamma Knife radiosurgery, which focuses up to 201 cobalt-60 beams of gamma radiation at a central point of “convergence” within the brain.

Gamma Knife radiosurgery has been known for some 50 years, but it has only come into widespread use with the advent of modern imaging techniques, such as enhanced MRI and CT.

In December 1999, St. Luke’s Medical Center became the first medical center in Wisconsin to open a Gamma Knife Center to treat patients with primary brain tumors. At the time, we expected to treat approximately 50 patients a year, but our forecasts were off by half. In the two years since the center opened, we have treated over 200 patients using Gamma Knife radiosurgery.

Although it is technically restricted to treating brain lesions, the Gamma Knife can treat a whole spectrum of indications – malignant and benign tumors, metastatic cancer, arteriovenous malformations and functional lesions such as intention tremors and trigeminal neuralgia, formerly known as tic douloureux. All patients treated with Gamma Knife have had independent consultations with a neurosurgeon and radiation oncologist, and every case is prospectively presented at St. Luke’s Medical Center’s Tuesday morning Brain Tumor Conference.

Gamma Knife radiosurgery is complex, requiring the coordinated efforts of neurosurgeons, radiation oncologists, neuroradiologists and medical physicists. The strategy is to accurately identify a target with diagnostic imaging, generate 3-D images of the target and radiation-sensitive brain structures, then create a treatment plan that divides the brain target into multiple treatable regions, each of which will be a point of convergence. This allows the overall target to receive a high dose of radiation while significantly sparing adjacent, normal tissue.
The procedure lasts between one and three hours. Under local anesthesia, a lightweight four-pinned frame is placed on the patient's head to hold him or her still. Using either a CT scan, an enhanced MRI or an angiography, an image map is made of the patient's brain. Images of the brain are transferred to a computerized treatment planning system, which isolates the target area and determines its coordinates. The patient's head is then positioned inside a helmet that has 201 portals through which the gamma rays are emitted. Throughout, the patient is sedated and feels no pain.

Overnight hospital observation depends on the patient's specific characteristics, but given the typically low risk of acute morbidity, Milwaukee-area patients may be given the option of immediate discharge with planned follow-up.

With malignant primary brain tumors, Gamma Knife treatment is inherently more complex than when it is used for benign lesions because of the typical blurring of malignant tumor margins. That is especially true in edema-producing tumors, which can result in underestimating and undertreating of the tumor. In these cases, Gamma Knife radiosurgery may be offered following external beam radiation that incorporates field margins around the enhancing radiographically visualized target.

Many patients have malignant brain tumors that exceed the technical size limits of Gamma Knife treatment. For patients meeting treatment criteria, the radiographic response to, and local control from, Gamma Knife treatment is encouraging; however, long-term survival nevertheless remains suboptimal. Current treatment strategies for a high grade tumor such as glioblastoma multiforme, for example, entail initial surgical intervention, conformal external radiation, chemotherapy and clinical trial options for anticipated eventual local failures. The role of Gamma Knife treatment for such tumors requires further definition via clinical trials and outcomes studies.

Benign primary tumors should be surgically removed by the neurosurgeon whenever they cause local symptoms, mass effect or when a biopsy is required. For a clinically diagnosed or recurrent benign tumor, Gamma Knife treatment offers a non-invasive but highly effective method for tumor control. The historically published control rate for acoustic neuromas, for example, exceeds 85 percent, with minimal risk of treatment complications.

On balance, our overall experience treating benign and malignant brain tumors at St. Luke's Gamma Knife Center has been positive. For clinically diagnosed or recurrent benign brain tumors, it offers a highly effective, viable alternative to surgery. And, with the continuing evolution of clinical innovations and advances in radiographic imaging, we are optimistic that Gamma Knife “boosting” will have a greater role in combating newly diagnosed and recurrent malignant brain tumors in the future.
Cancer of the brain or spinal cord is relatively rare, representing only 1.5 percent of all cancers reported in the United States. Nevertheless, its incidence has increased 50 percent over the past decade. According to the American Brain Tumor Association, about 20,000 people are diagnosed with primary brain tumors each year, and approximately 50 percent experience relapses despite aggressive treatment.

Regardless of the type of brain tumor, the neurosurgeon’s challenge has always been to locate and isolate the lesion, and determine whether it can safely be resected without sacrificing function.

Surgical resection can successfully treat both benign and malignant tumors. The type of tumor, size, location, symptoms and the neurological deficit caused by the brain tumor help determine if surgical resection is a viable option.

Many benign tumors – acoustic neuromas, meningiomas and pituitary adenomas – can be effectively treated surgically. When symptoms such as weakness, numbness or diminished consciousness are rapidly progressing, an immediate therapy is necessary. Neurosurgical intervention can reduce the mass causing the deficit and restore some or all of the function.

Acoustic neuromas can be surgically resected. This allows for definitive diagnosis, complete tumor removal and possible preservation of hearing. With an open surgery, however, there is risk of infection, hemorrhage or damage to the facial motor and/or sensory nerves. Gamma Knife stereotactic radiosurgery is proving highly effective in treating acoustic neuromas with decreased perioperative morbidity; however, there may be some delayed effect on facial motor or sensory function. Acoustic neuromas larger than 3 cm must be treated with conventional surgery.

Neurosurgery is often successful for total or subtotal resection of meningiomas. Some meningiomas have a large blood supply, however, and the tumor cannot be safely resected without substantial blood loss. To reduce this blood loss, endovascular therapy is used to block off the
feeding arteries. A catheter is inserted into the patient’s femoral artery, and advanced to the brain and the artery supplying the tumor. Particles such as PVC or glue are injected to close off the tumor's blood supply. Surgical resection is performed a day or two later, but with significantly less blood loss, thereby decreasing the need for blood transfusion. For meningiomas that are deep or in delicate areas, radiosurgery with Gamma Knife is an effective alternative.

Most malignant brain tumors are metastatic. The two most common primary sites are lung and breast carcinomas. When brain metastases are solitary, neurosurgical resection is the treatment of choice. Stereotactic radiosurgery with Gamma Knife is appropriate for multiple metastatic lesions, especially melanomas and renal cell cancers.

The most common primary malignant brain tumors in adults are gliomas (astrocytoma, anaplastic astrocytoma or glioblastoma multiforme), accounting for 65 percent of all primary central nervous system tumors. Some gliomas may be safely resected both initially and at the time of recurrence, depending on the stage and location. However, complete resection is often difficult, because gliomas (fibrillary, anaplastic and glioblastomas) can infiltrate into the surrounding normal brain. For pilocytic astrocytomas, complete removal is often possible.

New devices and less invasive techniques now make malignant and benign tumor resections more precise than ever, with less patient trauma. One device now available at St. Luke’s Medical Center is the Stealth Computerized Navigational System. Using CT or MRI imaging data to build a 3-D model of a patient’s head, the neurosurgeon can navigate to the tumor through the safest and most direct path, with a smaller incision and a smaller opening in the skull. The Stealth technology also lets us avoid important brain structures before they can even be seen in the surgical field.

Although we are able to approximate the location of the eloquent brain that corresponds with certain functions, we find that these areas do vary among individuals. To identify these eloquent areas, we often employ brain mapping.

Brain mapping is truly a team effort. The neurosurgeon exposes the areas of the brain thought to be affected, while the patient – who is awake and alert – is examined by a neurologist or other specialist trained in the technique. The patient’s head is fixed in place to keep it immobile.

If the area of the brain involved includes the speech center, the neurologist might show the patient pictures of objects that are normally recognized easily – say, a horse or a tree. The patient is asked to identify the pictures while the neurosurgeon stimulates the area thought to be the speech center with low-voltage electric current. In the case of a patient with motor function impairment, the neurologist might ask him or her to perform a simple motion, such as opening and closing the hand or moving the toes, while the neurosurgeon stimulates the motor area.
of the brain. If there is a disruption of either speech or motor functions while the brain is being stimulated, that area is considered critical and cannot be resected without loss of function. So for this reason, certain brain tumors remain inoperable.

If chemotherapy is the treatment of choice for brain cancer, a polymer wafer may be implanted during brain surgery. The wafer emits a regular dose of chemotherapy that attacks only the cancer site while sparing healthy tissue. This has proven effective in shrinking brain tumors that responded to no other treatment.

All of these neurosurgical innovations offer patients with benign and malignant brain tumors a promising array of new options.
Chemotherapy for brain tumors

The most commonly encountered types of malignant brain tumors of the central nervous system in adults are glioblastoma multiforme and anaplastic astrocytoma. Traditionally, the treatment of choice for glioblastoma multiforme has been radiation therapy and surgery. While prolongation of survival in adults has been shown with those modalities, median survivals of only 12-13 months have been reported, and recurrences following radiation therapy are often not treatable with additional radiation. Surgery at present is usually reserved for diagnostic purposes, although extensive tumor debulking can improve long-term survival compared to more limited resections. Radiation therapy alone has also been demonstrated to improve survival in clinical trials, although the improvement is modest. For this reason, the role of chemotherapy is being evaluated.

One challenge for medical oncologists treating brain tumors is to identify patients who are most likely to respond. Current recommendations for treatment of patients with newly diagnosed malignant glioma with chemotherapy are based on studies that did not take into account factors that have since been shown to influence outcome, including age, Karnofsky performance status and tumor histology. For example, younger patients undergoing successful resection of tumor with high performance status and tumors other than glioblastoma multiforme do better than older patients or those with glioblastoma diagnosed by biopsy alone. Furthermore, many of the earlier studies lack substantial statistical power to reliably detect outcome differences within these patient subsets.

Perhaps the most established role for chemotherapy has been as an adjunct to radiation therapy. The largest evaluation of chemotherapy in this setting, with a META analysis, included 16 published studies between the years 1975 and 1989 involving more than 3,000 patients with all types of brain tumors. This analysis showed increased survival in patients who received chemotherapy and radiation compared to those receiving radiation alone. However, the only groups that benefited were those with anaplastic astrocytoma or glioblastoma multiforme. In general, such patients had a good performance status, minimal residual disease and a younger age. Those studies established the role of chemotherapy in such tumors.
Chemotherapy alone also has been used, either as a single agent (in most cases BCNU) or combination chemotherapy with a three-drug regimen (PCV). In a Northern California Oncology Group phase-III trial, patients with anaplastic astrocytoma who were treated with the combination had a median survival of 157 weeks vs. 182 weeks for BCNU. In patients with glioblastoma multiforme however, there was no difference between the two. Therefore, because of the ease of administration, single agent BCNU has become standard treatment for such patients.

One interesting twist on this therapy has been the development of intracranial chemotherapy in the form of dissolvable BCNU wafers. This approach has been appealing because of the inability of many chemotherapy agents to cross the so-called blood/brain barrier. BCNU wafers have been placed surgically at the time of resection or primary diagnosis and through a slow release mechanism are allowed to penetrate the tumor substance over a longer period of time. While the depth of invasion of BCNU from the wafers is relatively limited in clinical practice, interstitial pressure may allow for more extension in the tumor bed, and therefore this approach may be more effective. Unfortunately, the kinetics of drug dispersal in this setting are more difficult to predict, and variable systemic absorption results in a more unpredictable effect on the bone marrow and potentially on hematologic toxicity. It remains to be seen whether responses to this treatment exceed more conventional BCNU trials.

Chemotherapy alone has been studied in patients who fail first-line therapy or relapse after primary radiotherapy. It is in this setting that most new drugs for this disease have been tested. Increasingly, inhibitors with signal transduction and angiogenesis as well as anti-invasion agents are being evaluated. Molecular markers on tumors may also help identify those patients who are chemosensitive and therefore would be good candidates for this approach.

Temozolomide is a new therapeutic agent for brain tumors that shows considerable promise. This drug is an oral, second generation alkylating agent, shown to have significant activity in preclinical trials. It is given as a five-day course once a month and achieves both systemic and intracranial levels. In a phase-II trial of recurrent anaplastic gliomas, combined response and stabilization rate of 60% was found with temozolomide with a progression-free survival at the rate of 48% at six months. Currently, there are phase-II and phase-III trials being conducted as well as trials combining this agent with standard treatments for these tumors. The results of these trials are obviously eagerly awaited. Temozolomide is very well tolerated and has few significant side effects. It can be given repeatedly without cumulative toxicity, and response rates in the range of 30% – 50% are encouraging more trials of this agent.

Another new drug, Irinotecan or CPT-11, is an analogue of the drug camptothecin. This is an intravenous medication which has been approved for patients with colon cancer and inhibits a critical path in DNA replication and transcription.
Early trials being conducted on malignant gliomas have demonstrated a good response with CPT-11 when used as a single agent. In one study, 60 patients with recurrent gliomas were treated weekly for four weeks followed by a two week rest period, and partial responses were seen in 10 of the 49 evaluable patients with glioblastoma multiforme. Toxicity was minimal, suggesting that more studies are worthwhile. Currently, new phase-I and phase-II trials are being conducted.

Matrix metalloproteinases are a family of enzymes responsible for normal turnover and remodeling of the extra-cellular matrix. Those enzymes are required for tumor angiogenesis and invasion. Inhibitors therefore would be expected to be active in preventing dissemination and growth of such tumors. One such drug, marimastat, is being evaluated in a phase-III trial for patients with newly diagnosed glioblastoma multiforme. This study randomized patients to receive marimastat or a placebo following external radiation. Results are expected soon and hopefully will show promise in this disease.

Angiogenesis inhibitors have been looked at for a variety of tumors including brain tumors, and while the results are not as enthusiastic as the preclinical trials have suggested, these studies have shown efficacy in brain tumors. One of the most promising of these agents is thalidomide. Thalidomide is a drug most commonly known by the lay public for its effect on newborns. When taken by pregnant women it caused severe birth defects with short limb syndrome, a side effect that ultimately led to its removal from the market. However, this drug has recently been revived as an anti-cancer agent and is a potent inhibitor of angiogenesis. It has been shown to block angiogenesis generated by endothelial growth factor and this characteristic makes it appealing in gliomas. A phase-II trial using thalidomide for patients with recurrent high grade gliomas has shown favorable responses and, based on this data, a phase-III trial is being opened to evaluate patients with recurrent disease. In addition, phase-II trials are now being evaluated to combine thalidomide with carboplatin or BCNU in treatment of recurrent gliomas, since thalidomide has virtually 110 additive hematologic toxicity.

Despite all of the encouraging trials outlined above however, the treatment of gliomas with chemotherapy remains a challenge. Several negative studies have been published over the past couple of years, and high response rate chemotherapy trials remain to be reported. Future improvements in survival for this tumor will depend on identifying patients with chemosensitive disease and then combining drugs that have complementary activity without overlapping toxicities. Clearly, research in this area will take many years to develop, but the pace of new drug development is quickening in this disease and optimism concerning new discoveries remains.
Brain tumors are a complex and variable group of diseases. These tumors can arise either directly from tissue within or around the brain or spread to the brain from where they originally developed elsewhere in the body. Additionally, the behavior of brain tumors is highly variable. Certain benign tumors grow so slowly they may never become symptomatic while many high grade primary brain gliomas are so aggressive that even with multidisciplinary combination therapies their prognosis is poor. Because of the inherent variation in the behavior of tumors depending on their histology and location, the choice of optimal therapy often requires input from many medical subspecialties. Neurosurgery, radiation oncology, medical oncology, neuroradiology, pathology and neurology are a few of the disciplines which provide input needed to determine the appropriate treatment scheme for any one individual.

Brain metastases are both a common complication of systemic cancer and a significant cause of cancer morbidity. The incidence of new brain metastases is increasing and currently numbers over 10,000 new cases a year. The reason for this increase in incidence is twofold: 1) the improvement in our treatment modalities for many cancers has prolonged survival and hence the propensity to develop brain metastases and 2) better imaging has allowed more accurate and earlier detection. Among the most common cancer histologies associated with brain metastases are lung cancer, breast cancer and melanoma.

Once diagnosed with brain metastases, the patient's prognosis depends on a number of variables including the number of lesions present, the location of the metastases, the tumor histology and the performance status of the patient. The median survival without any treatment is approximately 1 month. The use of steroids to treat vasogenic edema can increase median survival to 2 months. The addition of whole brain radiotherapy further increases median survival to 3 to 6 months. The rationale for using radiation therapy to treat brain metastases is that most chemotherapeutic agents do not cross the blood-brain barrier well, leaving the brain as a sanctuary site for tumor progression.

There are a number of treatment options available once a diagnosis of brain metastases is made. If a solitary metastasis is present, a study by Patchell has shown greater than a doubling in median survival if the lesion is resected in addition to
whole brain radiation therapy. Patchell also showed radiation therapy added to a solitary resection decreased by 50% the rate of distant brain progression. A recently presented randomized trial from Rhode Island in patients with 1 to 3 brain metastases has shown an increase in local control from 60 to 90% with Gamma Knife radiosurgery added to whole brain radiation. This study also found a 50% reduction in distant brain failure if whole brain radiation is used with radiosurgery.

Astrocytomas are the most common primary malignant tumor of the brain. In fact, 50% of all primary brain tumors are astrocytomas and 75% of these are glioblastoma multiforme or grade 4 astrocytomas. Surgery is the primary mode of therapy for astrocytomas with post-operative radiation or radiation with chemotherapy being the standard of care. The radiation delivered is 3-dimensionally conformal with computer planning based off of fused MRI and CT scans. The RTOG is currently studying the role of radiosurgery as a boost for high grade gliomas less than 4 cm in size.

Lastly, there are a number of benign brain tumors including meningiomas, pituitary adenomas, acoustic neuromas, etc. The treatment options for these tumors depend on a number of factors which must be individualized.

In conclusion, brain tumors vary in their histology, location, behavior, and overall prognosis. A wide variety of treatment options are available including surgery, 3-D conformal radiotherapy, intensity modulated radiotherapy, Gamma Knife and linac radiosurgery, chemotherapy, and hormonal treatments. For this reason, a multidisciplinary evaluation is needed to determine the most beneficial course of treatment in any one individual.
Pathology of brain tumors

Tumors of the nervous system include a large variety of neoplasms including benign and malignant tumors of the brain, intracranial peripheral nerves, meninges, pituitary and pineal gland and the skull.

The following descriptions correspond to the most common tumors encountered in the practice of pathology.

Diffuse Astrocytoma:
This astrocytoma corresponds to the WHO grade II. The histologic subtypes correspond to fibrillary, gemistocytic and protoplasmic astrocytomas.

The mean survival time after surgical intervention is in the range of 6 – 8 years with marked individual variation. A younger age and gross total tumor resection are considered predictive of delayed recurrence and progression. It is generally acknowledged that diffuse astrocytomas WHO grade II with a significant fraction of gemistocytes tend to undergo malignant progression more rapidly than the ordinary fibrillary astrocytomas.

Anaplastic Astrocytoma:
This astrocytoma corresponds to WHO grade III. The progression of an anaplastic astrocytoma to glioblastoma is a key prognostic factor. The time interval varies considerably with a mean of 2 years. The presence of an oligodendrogial component is associated with a significant increase in survival (>7 years). There is an increased survival rate in younger patients, high preoperative Karnofsky score and gross total resection.

Glioblastoma:
This astrocytoma and its variants correspond to WHO grade IV. Despite extensive clinical trials, individual prediction of clinical outcome has remained an elusive goal. Glioblastomas are among the most malignant human neoplasms with a mean total length of disease of less than one year in primary glioblastomas. Several studies suggest that...
the presence and extent of necrosis correlates with a poor clinical outcome. There is some evidence that complete resection favors longer survival and that young patients (under 45 years) have a considerably better prognosis than the elderly. Among other types of glioblastomas, although giant cell glioblastomas carry a poor prognosis, some reports indicate that the clinical outcome is somewhat better than that of the ordinary glioblastoma.

**Pilocytic Astrocytoma:**
This astrocytoma corresponds to WHO grade I. As a group, these tumors are slow growing masses, which at any point in their evolution, may stabilize or even regress. Rarely, pilocytic astrocytomas can be anaplastic. Most of these tumors are associated with growth and aggressive behaviors but others are cured by surgical excision with or without adjunctive radio or chemotherapy.

**Pleomorphic Xanthoastrocytoma:**
This tumor corresponds histologically to WHO grade II. For lesions with significant mitotic activity and/or with areas of necrosis, the designation of pleomorphic xanthoastrocytoma with anaplastic features may be used.

The overall survival has been estimated as 81% at 5 years and 70% at 10 years. The extent of resection of the original tumor mass appears to be the most significant predictive factor, followed by a low mitotic index. Mitotic activity is the only independent predictor of survival. Necrosis, although significantly associated with survival, was not an independent predictor.

**Oligodendroglioma:**
This tumor corresponds histologically to WHO grade II. The most frequent genetic alteration as determined by loss of heterozygosity (LOH) analysis is LOH on the long arm of chromosome 19 (ranging from 50% to more than 80% of cases) and LOH on the short arm of chromosome 1. Median post-operative survival time ranges from 3 to 5 years of all histologic grades. The mean survival rate of grade II oligodendrogliomas vary from 38% to as high as 76% 5-year survival and from 19% to as high as 59% 10-year survival. These tumors generally recur locally. Malignant progression on recurrence is not uncommon, although it is considered less frequent than in diffuse astrocytomas. Features associated with a more favorable outcome include younger age at operation, frontal location, post-operative Karnofsky score, lack of contrast enhancement on neuro-imaging, macroscopically complete surgical removal and irradiation after partial tumor resection.

**Anaplastic Oligodendroglioma:**
These tumors correspond histologically to WHO grade III. The reported median survival rate is 3.9 years and the 5 and 10 year survival rates are 41% and 20% respectively. Most patients die from local tumor recurrence.
Occasionally, patients may develop metastasis via the CSF or even systemic metastasis. A rare complication of oligodendroglioma and anaplastic oligodendroglioma is leptomeningeal oligodendrogliomatosis. Anaplastic oligodendrogliomas that have allelic losses on 1q and 19q are typically sensitive to procarbazine, CC/VU and Vincristine (PCV) chemotherapy. In addition, the presence of ring enhancement on initial neuroimaging has been reported to correlate to a lack of response to PCV.

**Oligoastrocytoma:**
These tumors correspond histologically to WHO grade II. The molecular genetics are more heterogeneous than those characteristically associated with pure oligodendrogliomas.

The median survival rate is 6.3 years and the reported 5 and 10 year survival rates are 58% and 32% respectively. Factors associated with longer survival include a younger age at surgery, gross total tumor resection and postoperative radiation therapy. From a clinical viewpoint, it has become increasingly important to differentiate between oligoastrocytomas and “pure” astroglial tumors because oligoastrocytomas, like oligodendrogliomas, appear to respond favorably to chemotherapy such as PCV.

**Anaplastic Oligoastrocytoma:**
These tumors correspond histologically to WHO grade III. The prognosis for these tumors is relatively poor, although still considerably better than for patients with a classic glioblastoma. The median survival rate is 2.8 years and the 5 and 10 year survival rates are 36% and 9% respectively. Survival rates increase when the patients are treated by surgery, irradiation and PCV chemotherapy. Patients with anaplastic oligoastrocytomas survive longer on average than patients with anaplastic oligodendrogliomas and patients with anaplastic oligoastrocytomas have a better prognosis than patients with pure anaplastic astrocytomas. In addition, there is evidence that glioblastomas with an oligodendrogial component are associated with longer survival rates than classical glioblastomas.

**Other Mixed Gliomas:**
These tumors are very rare and only occasional cases have been reported.

**Ependymomas:**
These tumors correspond histologically to WHO grade II. Four histopathologic variants have been described, i.e., cellular, papillary, clear cell, and tanycytic.

Generally, clinical outcomes in children appear to be significantly worse than in adults. Ages below 3 years, anaplastic histopathological features, incomplete tumor resection, and evidence of CSF metastases are indicators of a poor outcome in children. Survival rates at 5 and 10 years are 57% and 45% respectively according to one series, on adult patients. Supratentorial ependymomas are associated with better survival rates compared to posterior fossa neoplasms and spinal ependymomas show a significantly better outcome compared to cerebral lesions. Cerebrospinal dissemination indicates a poor prognosis.
**Anaplastic Ependymomas:**
These tumors correspond histologically to WHO grade III. Several studies indicate that there is no correlation between the survival of patients and classical histopathological signs of malignancy observed. A relationship with survival rates only becomes evident when high cell density and brisk mitotic activity were considered as independent variables.

**Myxopapillary Ependymomas:**
These slow growing tumors have a favorable prognosis and correspond to WHO grade I. Anaplastic variants are virtually unknown. This entity shows a good outcome with greater than a 10 year survival rate after total or partial resection. Late recurrence and distant metastases are very uncommon and subarachnoid dissemination has occasionally been observed.

**Subependymomas**
These tumors correspond histologically to WHO grade I. Subependymomas carry a good prognosis and surgical removal is usually curative.

**Choroid Plexus Tumors:**
Choroid plexus papillomas correspond histologically to WHO grade I. Choroid plexus carcinoma corresponds to WHO grade III. Histologically, choroid plexus tumors are divided into papillomas, carcinomas and atypical choroid plexus papillomas. The papillomas can be cured by surgery with a 5 year survival rate of 100%. The carcinomas grow more rapidly and have a less favorable outcome with a 5 year survival rate of 40%; meningeal dissemination and systemic metastases may occur. Gross total resection appears to be the treatment of choice for carcinomas. The poor prognosis of these tumors correlates with mitosis, necrosis, brain invasion and decreased expression of S100 protein. Carcinomas also may produce frank metastases along CSF pathways.

**Meningeal Tumors:**
Most meningiomas are benign and can be grouped into WHO grade I. Certain histologic subtypes are associated with a less favorable clinical outcome and correspond to WHO grade II and III (please refer to table below).

<table>
<thead>
<tr>
<th>Meningiomas Grouped by Likelihood of Recurrence and Grade</th>
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<tbody>
<tr>
<td><strong>Meningiomas with low risk of recurrence and aggressive growth</strong></td>
</tr>
<tr>
<td>Meningothelial meningioma</td>
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<tr>
<td>Fibrous (fibroblastic) meningioma</td>
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<tr>
<td>Transitional (mixed) meningioma</td>
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<tr>
<td>Papillomatous meningioma</td>
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<tr>
<td>Angiomatous meningioma</td>
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<td>Myxoeystic meningioma</td>
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<td>Seerery meningioma</td>
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<tr>
<td>Lymphplasmacyte-rich meningioma</td>
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<tr>
<td>Metaplastic meningioma</td>
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<tr>
<td>Atypical meningioma</td>
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</tbody>
</table>

Meningiomas of any subtype or grade with high proliferative index and/or brain invasion

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*In depth articles*
Mutations in the NF2 gene are detected in up to 60% of sporadic meningiomas. The major clinical factor in recurrence is the extent of resection, which is influenced by the site of occurrence, attachment to intracranial structures and the age of the patient. In one series 20% of gross totally resected benign meningiomas recurred within 20 years. Overall, tumor grade provides the most useful histological predictor of the likelihood of recurrence. While benign meningiomas have recurrence rates of about 7 – 20%, atypical meningiomas recur in 25 – 40% of cases and anaplastic meningiomas have recurrence rates of 50 – 78%. The absence of progesterone receptors, a high mitotic index and higher tumor grade were significant factors in shorter disease-free intervals in meningioma patients.

**Tumors of Cranial and Peripheral Nerves**

Tumors of the cranial and peripheral nerves include a wide range of histopathological features and associated clinical characteristics. These tumors frequently occur in the setting of familial cancer syndromes, in particular the neurofibromatoses. Two of the major clinicopathological entities include:

**Schwannoma (WHO grade I)**

Schwannomas can occur anywhere in the peripheral nervous system but intracranially its most frequent site is the vestibular division of the eighth cranial nerve. Surgical resection is usually the curative modality for this benign, slow-growing neoplasm. (See photo on right)

**Neurofibroma (WHO grade I)**

This tumor is usually solitary and indolent with a favorable prognosis. Multiple neurofibromas are the hallmark of von Recklinghausen Neurofibromatosis (NF1).

**Hematopoietic System Tumors**

The increasing incidence of CNS malignant lymphomas over the past two decades can be attributed by the HIV-1 epidemic, since up to 10% of terminal AIDS patients develop an Epstein-Barr virus (EBV) that is associated with malignant cerebral B-cell lymphoma. The vast majority of primary CNS lymphomas are malignant B-cell lymphomas which unlike their systemic counterparts, carry a poor prognosis. Rare lymphomas involving the nervous system include T-cell lymphomas, plasmacytoma, angiotropic lymphoma and Hodgkin's disease.

A variety of histiocytic tumors and histocytoses, more commonly encountered at extracranial locations, may also arise within the CNS.
The presence of a psychiatrist in the care of a patient with a brain tumor is often necessary. In fact, reports of psychiatrists being the first physician to suspect a brain tumor in a patient are not uncommon. Brain tumors command special vigilance and attention as patients develop neuropsychiatric symptoms in 50%\(^1\) of cases and one study reported the incidence of symptoms as high as 78%.\(^2\) Psychiatric and behavioral symptoms include psychosis, mood disorders, anxiety, delirium and personality changes.

Etiologies of brain tumors may be from a primary intracranial mass or may be representative of a metastatic process from an anatomically distant site. The most common tumor types of primary lesions (in order of frequency) include gliomas, meningiomas and pituitary adenomas. Metastatic CNS tumors (also in order of frequency) originate from the lung, breast, kidney and gastrointestinal system.\(^3,4\).

**Role of Psycho-Oncology in Diagnosis**

The occurrence of one or more of the following signs and symptoms in a known psychiatric patient or in a patient presenting for the first time with psychiatric symptoms should heighten the index of suspicion for a brain tumor\(^5\): a) seizures – especially if of new onset in an adult and if they are focal or partial, b) headaches – especially if new onset, generalized and dull, increasing in severity, or positional or nocturnal, c) nausea and vomiting – especially in conjunction with headaches, d) sensory changes – especially visual changes, auditory changes, or vertigo, and e) focal neurologic signs and symptoms.

**Modifiers of Neuropsychiatric Symptoms**

A number of factors can increase the chances that a patient with a central nervous system tumor develops psychiatric symptoms. These risk factors include:\(^5\): a) increased intracranial pressure, b) lower level of premorbid functioning, c) presence of a pre-existing primary psychiatric disorder, d) rapid rate of tumor growth, e) presence of multiple metastatic lesions, f) tumor type—especially if meningioma with transglobal extension, g) laterality (REFER TO TABLE 1), and h) location (REFER TO TABLE 2).

**Table 1: Laterality of CNS Tumor**

<table>
<thead>
<tr>
<th>Location</th>
<th>Common Psychiatric Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right-sided tumor</td>
<td>Mania, confusion</td>
</tr>
<tr>
<td>Left-sided tumor</td>
<td>Depression, apathy</td>
</tr>
</tbody>
</table>

**Psychiatric Manifestations of central nervous system tumors**

Jeffrey J. Knajdi, MD, Medical Director
Vince Lombardi Cancer Counseling and Psycho-oncology Services
Treatment

Psychotherapy with patients with neuro-oncologic problems can be challenging, yet very helpful if facilitated by a well-seasoned therapist. Holland identified key issues most brain tumor patients face that can be addressed in psychotherapy including concerns about disability, dependency, disruption, disfigurement, and death. Psychotherapy is generally supportive in nature but also involves elements of crisis intervention and solution-oriented approaches. Relaxation therapy can be useful as an adjunct to analgesics for headache pain control. Encouraging patients to keep a diary of their sessions can help those struggling with memory problems so that therapy does not become yet another frustrating experience lost to tumor-related amnesia. Other purposes of therapy include work involving anticipatory bereavement, family support, and dialoguing with the patients the benefits that psychotropic medications can provide in relieving distress and maximizing quality of life. Psychopharmacologic agents can be useful in the treatment of symptoms of agitation, depression, and anxiety. While placebo-control studies about the use of psychiatric medications in patients with brain tumors are povertous, clinical experience has shown that use of these medications is critical in symptom management.

Table 3 represents a summary of some key points to consider when administering psychotropic medications to this population. The totality of symptoms seen with a brain tumor is a medical and psychiatric matrix that demands special attention. For patients who are plagued by psychiatric symptoms secondary to a CNS tumor, multiple benefits are attainable when consultation is arranged with a professional with clinical expertise and experience in this complex psycho-oncological presentation.
Table 3: Key Points to Consider in the Use of Psychotropic Medications in Neuro-Oncological Patients

1) Higher risks for side effects exist, so smaller doses of medications may be needed. The phrase “Start low (in dosing) and go slow (when titrating)” highlights this precautionary measure.

2) Limit or avoid the use of agents with anticholinergic properties (i.e., tricyclic antidepressants, low potency neuroleptics) secondary to risk of delirium.

3) Cautious use of benzodiazepines is suggested because of risk of delirium as well as paradoxical reactions or disinhibition syndrome.

4) Procarbazine has monoamine oxidase inhibitor activity and concomitant use with antidepressants or psychostimulants is contraindicated.

5) High dose steroids, especially in excess of 60-80 mg of prednisone per day (or its equivalent) can cause symptoms ranging from anxiety or depression to severe psychosis or mood instability. Neuroleptics (and benzodiazepines in a few cases) are preferred to counteract this iatrogenic event.

6) Even though almost all neuroleptics can lower seizure threshold, drugs such as haloperidol and some of the newer atypical anti-psychotics are excellent “first choices” for agitation and confusion, anxiety, or some cases of insomnia. Note that haloperidol, when administered intravenously, is generally devoid of extrapyramidal side effects.

7) Treatment of depression, cognitive slowing, or fatigue can be approached with the use of psychostimulants (i.e., methylphenidate, dextroamphetamine) administered twice per day at 7 or 8 a.m. and again at 12 or 1 p.m.

8) Treatment of depression is preferred with SSRIs or atypical/newer antidepressants but a psycho-oncological consultation is suggested. The unwanted properties of anticholinergic side effects seen with paroxetine, the theoretical decrease in seizure threshold with bupropion, and other numerous drug-drug interactions are examples of events that can be avoided with the help of a psycho-oncology referral.

References

Brain and Central Nervous System PCE Distribution of Malignant Versus Benign Cases

As displayed in the graph, benign brain/CNS tumors were more prevalent at AHC-Metro in the year 2000, accounting for about 57% of the cases included in the PCE study (59 cases out of a total of 103 cases). As reported through the CBTRUS, malignant brain tumors are the most frequently reported. The overall incidence rate for primary brain and central nervous system tumors was 12.7 per 100,000 person years (adjusted using the year 2000 standard).
The graph on the left represents relative survival of malignant brain and CNS tumor patients with combined stages of diseases who were reported between 1988 and 1992. The results demonstrate a comparable outcome curve between Aurora's Metro patients* compared to those reported nationally to the Surveillance, Epidemiology and End Results (SEER) program of the NCI.

*excludes spinal and cerebral meningeal tumors

Of the five prior medical conditions collected in the PCE, a significant percentage (40%) of Aurora patients had a history of hypertension; followed by 16% who carry a history of diabetes.

Comparison data through the CBTRUS and/or NCDB is not available at this time.

In aggregate, the largest number of brain/CNS cases seen in AHC-Metro Region have a size of less than 40mm. (Includes both benign and malignant cases.)

Comparison data through CBTRUS and/or NCDB is not available at this time.
Here within AHC-Metro, tumors located in the meninges accounted for the largest majority of the CNS tumors with 29% (29 cases) (including both benign and malignant), with tumors in the cerebrum at 22% (21 cases), 20% as other (including all lobes and overlapping lesions) and acoustic nerve tumors with 20% (19 cases) coming in second and third respectively.

According to the CBTRUS the most frequently reported histology is a meningioma (predominantly a benign tumor), which accounts for over 25% of all brain/CNS tumors, followed by glioblastomas and astrocytomas. Here in AHC-Metro during the year 2000, meningiomas accounted for 35%, acoustic neuromas 24%, and glioblastomas 18% of our Brain/CNS tumors (this includes only those cases that qualified for the 2000 PCE).
Regional Activities
in Aurora’s Metro Region
The year 2001 has been a very exciting year for Aurora Health Care, as a new department had been established late last year. This was the Clinical Research Department and after a very long nationwide search, a new Director was named to head up this endeavor.

Dr. Bryan J. Tucker came to Aurora from San Diego in October of 2000, and while the department is a system-wide department, the majority of the studies it is supporting are focused in the Metro Region.

The number of oncology studies supported by the Clinical Research Department or by private physician groups have increased significantly over the last couple of years and include all of the oncology treatment areas. Aurora Health Care continues to support six major oncology cooperative groups, which include National Surgical Adjuvant Breast Program (NSABP), the Eastern Cooperative Oncology Group (ECOG), the Cancer and Leukemia Group B (CALGB), the Radiation Therapy Oncology Group (RTOG), the Sarah Canon Cancer Network, and the American College of Surgeons Oncology Group (ACOSOG). In addition, patients have access to numerous genetic, quality of life, pharmaceutical and cancer prevention clinical trials.

While clinical trials that focus on treatment options for our patients continue to be the majority of the studies at Aurora Health Care, the year 2001 has brought different types of oncology studies as well. The SELECT trial is looking at the use of Selenium and Vitamin E for the prevention of prostate cancer. Two new genetic studies for the detection of breast cancer include the use of saliva, looking for c-erB-2 and a study that looks at actual breast cancer tissue for the discovery and evaluation of biomarkers. Some additional new studies include one that is looking at the treatment of cancer cachexia and one looking at quality of life issues for breast cancer women undergoing chemotherapy.

Bringing cutting edge technology and new treatment options to our patients is a very rewarding result of participating in clinical research. As we continue to build new relationships with study sponsors, the number of options available for our oncology patients will continue to grow.

For information regarding oncology studies or who to contact, please call Carol Tutino at 414-649-5526.
The Vince Lombardi Cancer Clinic's (VLCC) approach is to fight cancer on all fronts with education, prevention, diagnosis, treatment and support. By offering all-encompassing care through a coordinated team effort, patients and families can have their cancer care needs met through the Clinics, which are conveniently located throughout southeastern Wisconsin:

Vince Lombardi Cancer Clinic – St. Luke's Medical Center
Vince Lombardi Cancer Clinic – St. Luke's South Shore
Vince Lombardi Cancer Clinic – Aurora Sinai Medical Center
Vince Lombardi Cancer Clinic – Slinger
Vince Lombardi Cancer Clinic – West Bend
Vince Lombardi Cancer Clinic – Kenosha
Vince Lombardi Cancer Clinic – Lakeland Medical Center
Vince Lombardi Cancer Clinic – Manitowoc
Vince Lombardi Cancer Clinic – Sheboygan

The Vince Lombardi Cancer Clinics continually work together to improve service to patients and their families. A current project underway is to improve patient and family knowledge and understanding of chemotherapy side effects. A group of registered nurses from all of the sites are putting together a special binder for patients that will contain the information needed as they journey through the various stages of cancer care from initial diagnosis to treatment and then post treatment. The binder will be available in 2002.

Another way the Clinics support their patients and families is through participation in research protocols. Currently, there are more than 30 research protocols available to patients with different cancer diagnoses such as breast, prostate, colon, lung, renal and melanoma.

Every effort is always made to coordinate care through a patient's local VLCC or hospital. If specialized cancer services are required, patients have access to the tertiary hospital, St. Luke's Medical Center (SLMC). The VLCC at SLMC puts extensive effort into supporting unique, leading-edge therapies such as Immunotherapy and Autologous Bone Marrow Transplantation.

The VLCC at SLMC also supports all apheresis needs of cancer patients as well as any other patients in the hospital that require this service. The dedicated staff provides this service seven
days a week, 24 hours a day to encompass any emergent needs. This is a very unique program in that most hospitals contract from their local blood center. Recently, the American Association of Blood Banks recertified the VLCC apheresis program.

Supporting the needs of cancer patients also requires a dedication to recruiting and training future caregivers. Nationally, there is a shortage of caregivers and this is especially true of a specialty such as oncology. The Vince Lombardi Cancer Clinics and staff are committed to providing positive mentoring and learning experiences for students enrolled in university and technical programs as well as high school students enrolled in an INROADS program. The goal of the INROADS program is to place students of color in businesses, such as hospitals, and prepare them for corporate and community leadership.

The community link to all of the Vince Lombardi Cancer Clinics is a toll-free hotline (800-252-2990). Hotline staff put callers in touch with accurate answers to a variety of cancer questions ranging from prevention and detection concerns to how to access the latest treatments, research protocols and area support groups.
Our community outreach efforts focus on educating people in Eastern Wisconsin about the facts that increase the risk of developing cancer, identifying ways to reduce their risk, and emphasizing the importance of early detection.

One method of reaching that goal is via our Vince Lombardi Cancer Hotline. The hotline is a toll free service (800-252-2990) to respond to phone inquiries about cancer from consumers, patients, physicians and other health professionals. Hotline staff put callers in touch with accurate answers to a variety of cancer questions. Written information is often mailed to the caller or they are referred to one of the Vince Lombardi Resource Libraries located in each of our Vince Lombardi Cancer Clinics. The libraries offer computer access along with an extensive array of the latest videos, books and pamphlets that can be checked out.

Another method of outreach is that we continue to let our communities indicate the outreach activities that best meet their needs. These activities have included our cancer experts presenting information at local churches and businesses as well as partnering on “getting the message out” at larger events with local/regional and/or national patient advocacy groups. The American Cancer Society Relay for Life in Washington County, and the Susan G. Komen Breast Cancer Foundation-Race for the cure in Milwaukee County were two large events that rallied our patients and staff around a very significant message – that of life!

Harry Belafonte, entertainer and longtime activist, as well as a prostate cancer survivor, was the keynote speaker at Aurora Health Care’s Second Annual Men’s Health Conference in September 2001. The event was sponsored by a number of organizations, including Buddies Against Prostate Cancer, founded by radio personality Bob Reitman, former Brewers pitcher Ken Sanders and businessman Gary Grunau. Mr. Belafonte began his day seeing patients at the Vince Lombardi Cancer Clinic at St. Luke’s Medical Center and then visited the Gamma Knife Center and Immunotherapy Program. Speaking at a press conference in front of the VLCC, Belafonte, Reitmen and Sanders urged men to see their doctors, while discussing the commonalities shared among men who have survived prostate cancer.
At the Sheraton Hotel, Belafonte spoke of his life in entertainment and his worldwide travels to advocate for human rights causes and health concerns. His passion and humor held the attention of an audience of approximately 800.

In addition to Belafonte's poignant speech, the Men's Health Conference included a talk on male breast cancer by survivor and author Michael Samuelson, as well as educational booths focusing on a variety of men's health issues including heart care, colon cancer, stroke prevention, mental health issues and sleep disorders.
Cancer support groups

Cancer support groups are for people whose lives have been touched by cancer. They provide education, a sharing of experiences and inspiration. These groups, for many, are critical components to comprehensive cancer treatment.

Psycho-educational groups, for example, play important roles in focusing on information and improving compliance with treatment. Some studies have shown brief structured interventions not only can improve mood and coping but immunity as well. Several studies have focused on the correlation between the adequate training of the group facilitators and the effectiveness of the groups themselves. Our particular program incorporates general support group facilitator training, but also focuses on introducing group leaders to the art and science of the field of psycho-oncology as part of their education.

The first support group facilitator training was held Friday, June 22, 2001. Carol Ott, PhD was the course facilitator. This was a day-long training session in which Dr. Knajdl and Barbara Clinkenbeard, MS, NP incorporated principles of psycho-oncology into the training. There is no charge to the staff for this psycho-oncology support group facilitator training that will be held biannually.

A Time to Grieve
Third Thursday of each month from 1:30 p.m. to 3:00 p.m. at Aurora Health Center in Slinger.

The ABMT Support Group
For people who have undergone an autologous bone marrow transplant. Held at St. Luke’s Medical Center. Call the Vince Lombardi Hotline at 414-649-7200 for meeting dates and times.

Breast Friends - The Breast Cancer Support Group
For women who have been diagnosed with breast cancer, their families and friends. Meets the last Tuesday of each month from 6:00 p.m. to 8:00 p.m. at St. Luke’s Medical Center in the Cancer Counseling Center.

Care for the Caregiver Support Group
For individuals who care for an aging or disabled individual. Every other Thursday from 10:00 a.m. to 11:30 a.m. at West Allis Memorial Hospital.

Every Day Counts
First Wednesday and third Tuesday of each month from 1:00 p.m. to 2:00 p.m. at Aurora Health Center in Slinger.

Experiencing Grief Recently Widowed
For people who have lost a loved one and are going through the grieving process. Meets Tuesdays for eight weeks from 1:00 p.m. to 3:00 p.m. or 7:00 p.m. to 9:00 p.m. at St. Luke’s Medical Center. To register call 414-328-6280.
**Kids’ Connection**
To help children ages 5 through 18 cope when a parent or loved one has cancer. This group is offered periodically and meets for four weekly sessions from 6:00 p.m. to 7:30 p.m. at St. Luke’s Medical Center in the Immunotherapy Conference Room. Registration by custodial parent or guardian is required.

**Living Through Loss Support Group**
Designed to help people move through the grieving process. First and third Tuesday of each month from 10:00 a.m. to 11:30 a.m. or 6:00 p.m. to 7:00 p.m. at West Allis Memorial Hospital.

**Look Good... Feel Better**
For people who are undergoing cancer treatment. This program presents techniques to help people gain control and even triumph over the cosmetic side effects of treatment. Offered six Mondays per year from 1:00 p.m. to 4:00 p.m. Call 414-649-7200 for dates and pre-registration.

**Make Today Count**
For people with cancer or other life-threatening illnesses and their families. This group is a cooperative effort of St. Luke’s Medical Center and the American Cancer Society. Meets the fourth Thursday of each month January through October and the third Thursday of November and December (to accommodate the holidays) from 7:00 p.m. to 8:30 p.m. at St. Luke’s South Shore, 5900 South Lake Drive, Cudahy.

**Newly Diagnosed With Breast Cancer**
This support group meets weekly for six weeks and is offered four times a year. For more information call 414-649-7200.

**Ovarian Cancer Awareness Group**
For women who are at risk for or have been diagnosed with ovarian cancer. First Tuesday of each month from 6:30 p.m. to 8:00 p.m. at St. Luke’s Medical Center.

**Positive People**
Mutual support, socializing, advocacy, and education for persons with cancer, their families and friends is provided. It also offers an opportunity to share problems and concerns encountered while coping with this disease. For more information call 414-328-7405.

**Rebound – Living with Breast Cancer**
Rebound is a highly personalized and intimate support group for women who have recently been diagnosed with breast cancer. The rebound program works with breast cancer patients to address the physical and emotional adjustments they face during breast cancer treatment. Rebound meetings combine education on health-related topics, along with group sharing of feelings and experiences related to breast cancer. All information is strictly confidential. Meets Wednesdays from 4:30 p.m. to 6:30 p.m. at Aurora Sinai Medical Center's Behavioral Health Clinic.

**Refocusing On Hope - A Support Group For People With A Primary Brain Tumor**
For people who have been diagnosed with primary brain tumors, their families and friends. For information on the meeting location, dates and time, please call the Vince Lombardi Cancer Hotline at 414-649-7200.

**Us Too! - The Prostate Cancer Support Group**
For men who have experienced prostate cancer and their families and friends. Meets the first Wednesday of each month from 7:00 p.m. to 8:30 p.m. at St. Luke’s New Berlin Health Care Center, 14555 West National Avenue, New Berlin, in the Community Events Room.

**Women Supporting Women Breast Cancer Survivor Group**
For women of color who have experienced breast cancer. Meets the third Saturday of every month from 11:00 a.m. to 1:00 p.m. at House of Peace, 17th and Walnut.
**Your Caring Connection**

For patients experiencing cancer, their families and friends. Meets the second Monday of each month from 6:30 p.m. to 8:00 p.m. at St. Luke’s Medical Center in the Cancer Counseling Center. For more information, please call the Vince Lombardi Cancer Hotline at 414-649-7200.

**Future Goals for the Support Groups**

1) Support group held during the day for individuals who are unable to attend evening groups.

2) Training facilitators of support groups to bring specific attention to psychosocial issues associated with the stage of the disease and assess “readiness” of participants for the support group and whether psychotherapy (individual, family, or group) and referral to a psychiatric professional may be a more appropriate and effective intervention.

3) A six-week ongoing newly diagnosed breast cancer group is in the developmental stage. We plan to use the audio resource program “The Cancer Survival Tool Box.” The first meeting is to be announced and will be held in the Cancer Counseling Center at St. Luke’s Medical Center.

The Cancer Counseling Center will continue to offer support groups as part of the comprehensive psychosocial care available to patients and families. Research has demonstrated the effectiveness and importance of such groups especially as the groups reduce psychosocial distress by decreasing isolation, help to normalize the emotions associated with a diagnosis of cancer, provide answers to specific common problems, and enhance feelings of hope and heightened self-esteem.

**Pastoral Care Program**

Chaplains are professionally trained to provide spiritual and emotional support to patients and families who are dealing with cancer. Referrals are received from patients, families, physicians, nurses, social workers, community clergy, nursing assistants and volunteers.

Available 24 hours a day at all Metro Region hospitals, chaplains support patients of all faiths who are newly diagnosed with cancer, those who are undergoing chemotherapy, radiation therapy or bone marrow transplant. Skilled in working with issues of spiritual diversity, chaplains are important members of the cancer services team serving as spiritual companions who are often called upon to assist patients in communication with local clergy or provide for sacramental needs.
Multi-Disciplinary tumor boards and specialty case conferences are offered weekly and/or monthly to educate health care providers, improve the quality of care for our patients and to stimulate consultative discussion between various specialties.

The consultative forums allow physicians to present cases of special interest. An overview of the diagnostic findings is followed by a professional and consultative dialog among multi-specialists. The outcome consists of recommendations that lead the way for "Best" practice patterns for treatment. It is important to note that patient names are always withheld to protect a patient's confidentiality and privacy. To present a case call 414-649-7290.

The serial conferences listed below are open to all health care providers of Aurora Health Care.
## 2000 Primary Site Table for metro region cancer programs

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This report excludes carcinoma in situ cases of the cervix and basal cell carcinomas of the skin.

A=Analytical, N/A=Non-Analytical
3,138 new cancer cases were seen in the Metro Region in 2000. The number of new cancer cases has increased at all the facilities from the previous year of 1999. Site numbers include St. Luke's Medical Center 2,070 (includes SLSS) with 86% classified as analytical (diagnosed and or treated within the first course of treatment), Aurora Sinai Medical Center, 348 with 90% analytic, West Allis Memorial Hospital 608 with 94% analytic and Aurora Medical Center in Hartford with 112 cases of which 78% were analytic.

More women than men were seen at all Metro Region sites in 2000. In total, 1,771 or 56% were women with 1,366 or 44% being male. According to the estimated new cancer cases for 2002 based on the incidence rates from the NCI SEER program the sex ratio is even (50/50). State of Wisconsin's Cancer Incidence and Mortality Report for 1998, cancer rates were higher for women for all primary site groups. The annual cancer incidence rate was 423 per 100,000 population for males and 339 per 100,000 population for females. Of the total number of cases the incidence was split 50/50.

When comparing age differences among the Metro Region Hospitals we find younger patients being diagnosed at Aurora Sinai Medical Center with a mean age of 65. At St. Luke's Medical Center and West Allis Memorial Hospital the mean age is 75 with St. Luke's Medical Center showing a larger portion of the patients being diagnosed younger than the mean, whereas at West Allis Memorial Hospital, the patients are being diagnosed at ages slightly higher than the mean. Of the key findings of the Wisconsin Cancer Incidence and Mortality report is that 60% of the newly diagnosed cases in 1998 were age 65 and older.
The analytical percentages at each facility are as follows: St. Luke's Medical Center 88% classified as analytical (diagnosed and or treated within the first course of treatment), Aurora Sinai Medical Center 92% analytical, West Allis Memorial Hospital 91% analytical and Aurora Medical Center in Hartford 71% analytical.
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* Rev. Marcia Marino, Pastoral Care
* Linda Martin, BSW Social Services
* Jennifer Martone, RN, MSN Inpatient CNS
* Mary Mavraganis, MS Social Services
* Angela Mengelt, MS Genetic Counselor
* Donna Metoff, RN, MSN Inpatient Nursing
* Wendy Mikkelson, MD Breast Surgery
* Tracy Miller, Cancer Registry
* Mahmoud Mirhoeseini, MD Cardiothoracic Surgery
* Sara Moldenhauer, RN, BGAHJK
* David Mroz, MD Family Practice
* Sharon Neidinger, RN VLCC
* Michael Nordstrom, MD Otolaryngology
* William Pao, MD Radiation Oncology
* Nileshkumar Patel, MD Pain Management
* Wendy Paulson, SLSS Oncology
* Jorge Pellegrini, MD Pathology
* Roger Pelmam, MD Radiology
* J. Pickeral, MD Pathology
* Mitchell Pincus, MD Radiation Oncology
* Becky Pogacar, RN, MSN Nursing
* Kim Reed, RN Inpatient Nursing
* Diane Reif, RN Patient Care Manager
* Lisa Robinson, RHIA, CTR Clinical Data Registries
* Terence Roth, MD Surgery
* Mary Runge, RN, MBA VNA Hospice Services
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* Manja Weidman, RN, MSN Business & Market Dev.
* Mark Wenzel, MD Radiology
* Phil Whitten, RTI Manager Radiation Oncology
* Walter Wong, MD Radiation Oncology
* JoAnna Yeh, PharmD Pharmacy
* Sol Yoder, PharmD Oncology Pharmacy
* George Yu, MD Pathology