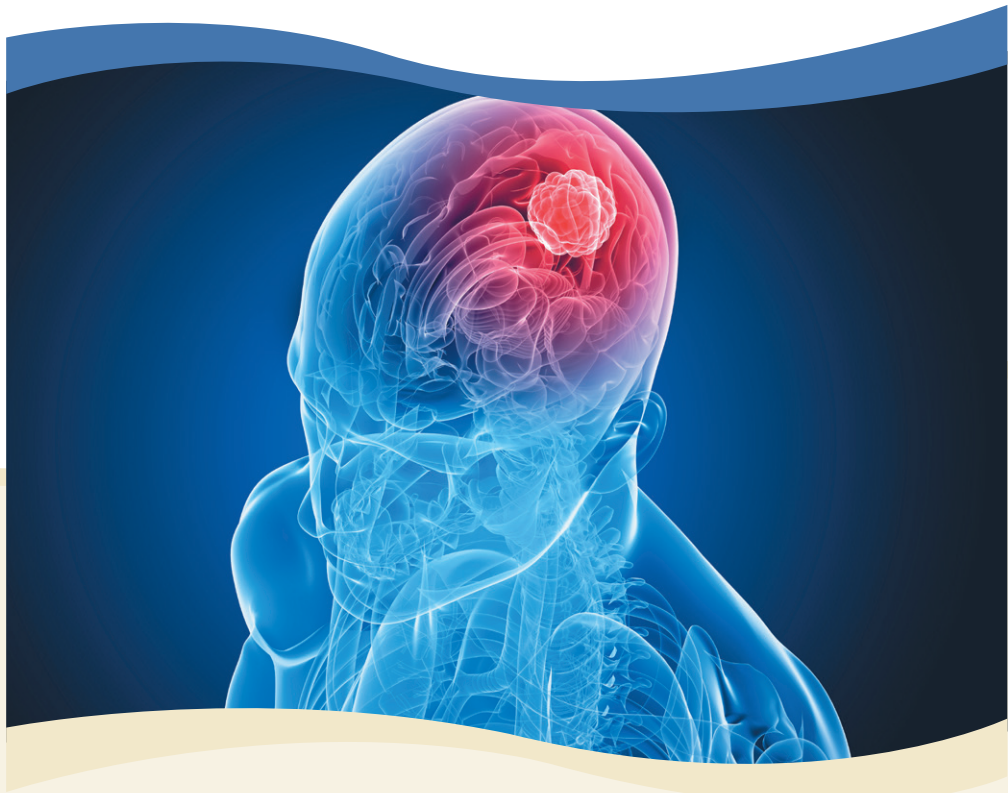


Legacy Cancer Institute Annual Report 2018 Brain and spinal tumors



Legacy Cancer Institute



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Brain and spinal tumors: Managing one of our toughest challenges

By Nathalie Johnson, M.D., FACS, medical director, Legacy Cancer Institute and Legacy Breast Health Centers

One of our toughest challenges in the world of cancer care is the treatment of brain and central nervous system tumors. The disease and the therapies can have a profound impact on the functionality of our patients. For instance, resecting tissue around a large tumor from the colon or breast is far more forgiving than removing a brain tumor that could affect leg function, speech or memory. And yet, there are many times compromises have to be made when treating with the intent to cure or gain durable control.



Managing the entire spectrum of the disease, such as physiologic, functional and emotional fallout from treatment, is equally as important in restoring our patients to health. This is where the Legacy Cancer Institute Brain and Spinal Tumor Program stands out. We truly exemplify multidisciplinary team care and patient centered care. In fact, Legacy Cancer Institute is one of only a handful of programs nationally accredited by the American College of Surgeons Commission on Cancer that has received commendation awards for over 12 years running for the integrated care provided.

What does this look like for our patients with brain or spinal tumors? Well, it starts with an amazing physician and administrative leadership found in Brian Ragel, M.D., Medical Director, LCI Brain and Spinal Tumor Program, and Pamela Kilmurray, LCI Service Line Director. It continues with the latest in technology and oncology clinical trials. It includes

a top-notch stereotactic radiosurgery program led by Andrew Kee, M.D., LMG Radiation Oncologist, combined with medical oncologists focused on the management of brain and spinal tumors through our collaboration with the OHSU Knight Cancer Institute. Then add the stellar oncology support team with oncology nurse navigation, social work, nutrition, clinical psychology, genetics, integrative care and art therapy that surround patients and their families with the support they need.

Physical and occupational therapy are critical in the recovery for many of our patients. One of the unique advantages of our program is our affiliation with the Legacy Rehabilitation Institute of Oregon, affectionately known as RIO, located at Legacy Good Samaritan Medical Center. It happens to be one of the best rehabilitation centers in the country.

RIO is an amazing resource for our patients who need more extensive rehabilitation for impairments post-treatment. Some of this rehabilitation happens in our internationally recognized healing gardens.

For a community-owned medical system in Oregon and Southwest Washington, we have amazing things going on. We are continually grateful for the support of philanthropy, which makes so much more possible. But even more so, for the focus of our team to serve others and provide the best care with compassion. That is us, the Legacy Cancer Institute . . . where healing, hope and heart are one.

Legacy Cancer Institute • Annual Report 2018

Comprehensive cancer services

For more information about our services, please visit legacyhealth.org/cancer.

Cancer care and treatment

- Cancer care conferences/tumor boards
- Cancer Care Inpatient Unit
- Cancer data management/cancer registry
- Cancer Rehabilitation Services
- Cancer screening and prevention
- Interventional radiology
- Legacy Breast Health Centers
- Legacy Cancer Healing Center
- Legacy Genetics Services
- Legacy Hospice/Legacy Hopewell House Hospice
- Legacy Medical Group—Gastrointestinal Surgery
- Legacy Medical Group—Gynecologic Oncology
- Legacy Medical Group—Pulmonary
- Legacy Medical Group—Radiation Oncology
- Legacy Medical Group—Reconstructive Surgery
- Legacy Medical Group—Surgical Oncology
- Legacy Pain Management Centers
- Legacy Palliative Care Services
- OHSU Knight-Legacy Health Cancer Collaborative
- Pathology
- Wound and ostomy care

Cancer programs and specialty areas

- Autologous stem cell transplant program
- Bladder cancer
- Blood cancers
- Brain and spinal tumors
- Breast cancer services
- Children's Cancer and Blood Disorders Program
- Colorectal cancer
- Esophageal cancer
- Gynecologic cancers
- Oral, head and neck cancer
- Hepatobiliary and pancreatic cancer
- Kidney cancer
- Lung cancer
- Melanoma
- Prostate cancer
- Stomach cancer

Clinical trials and research

- Current clinical trials
- Oncology clinical research
- Tumor bank

Support services — Adult

- American Cancer Society gift closet
- American Cancer Society patient navigator
- Cancer support groups and classes
- Cancer survivorship
- Expressive arts therapy
- Green Gables Guest House
- Integrative care and symptom management
- Lymphedema management
- Massage therapy
- Nutrition
- Oncology nurse navigators
- Pharmacy navigator
- Oncology psychology services
- Oncology social work
- Stress management
- Volunteer program

Support services — Pediatric

- Child Life Therapy
- Family Lantern Lounge
- Family Wellness Center
- Music Rx® Program
- Pediatric development and rehabilitation
- Ronald McDonald House
- School program
- Survivorship services and KITE Clinic
- Volunteer program

2018 reflection: adapt, transform and triumph

By Paul Tseng, M.D., MBA, gynecology oncologist, chair, Integrated Network Cancer Committee, Legacy Cancer Institute, medical director, Women's Cancer Service Line

We must continually adapt to triumph over cancer. Reflecting each year about how we serve our patients and ways to continually improve is at the



core of why we exist as a Cancer Institute. Our purpose is to continually improve treatment, outcomes and survival for our patients. Reflection is giving back to our patients. Therefore we continually transform our collective efforts to best treat

and serve.

Legacy continues its commitment to be patient centric. Our mission of comprehensive cancer care includes forward-thinking research platforms which allow clinical trial options for our patients. In 2018, LCI received main NRG membership which includes global access to clinical trials in breast, bowel and gynecologic cancers, as well as the full disease continuum of radiation oncology clinical research. LCI is a main member of the Alliance Cooperative Group which is the merger of three cooperative groups: the American College of Surgeons Oncology Group (ACOSOG), Cancer and Leukemia Group B (CALGB), and North Central Cancer Treatment Group (NCCTG). Legacy has an affiliate membership

through OHSU which gives us access to Southwest Oncology Group (SWOG) trials. The Legacy OHSU cancer collaboration gives our patients a multitude of treatment options. Legacy Cancer Institute stood out amongst the crowd with a National Cancer Institute Award for Research accrual and the data quality. We accrued the largest number of patients in the Tesaro Ovarian Cancer Study.

The clinical realm continues our patient-centric focus to ease the path of care for our patients. In 2018, Legacy Radiation Oncology implemented hypofractionation for multiple disease sites to decrease patient overall treatment time. Our priority is to provide patients with integrated, multidisciplinary oncology care. This includes the support of research, integrative medicine, palliative care, pharmacy, psychosocial and nurse navigation, to provide the latest in evidence-based care that is seamless and uncomplicated.

Legacy Cancer Institute will continue to reflect and give back, while frequently adapting to best serve and treat our patients. I invite you to join us in our efforts to triumph over cancer.

Integrated Network Cancer Committee Cancer Liaison Physician report

By Alizah Rotramel, M.D., FACS, colorectal surgeon, Legacy Medical Group—Colon and Rectal Surgery

The Integrated Network Cancer Program (INCP) Cancer Liaison Physician (CLP) serves in a leadership role within Legacy Cancer Institute. The CLP is responsible for evaluating, interpreting and reporting our program's performance using the American College of Surgeons (ACS) Commission on Cancer (CoC) National Cancer Database (NCDB) data to the Legacy Integrated Network Cancer Committee at least four times per year.



The NCDB Cancer Program Practice Profile Reports (CP3R) are reporting tools released annually by the CoC. The CP3R was designed to promote practice improvement and quality of care at the local level, as well as provide accredited hospitals with a tool to compare their care for patients with that of other institutions. The goal of the program is to unify the staff, clinicians and administrators in a collaborative effort to identify opportunities for im-

provement in care, implement best practices, optimize quality and diminish disparities in care across CoC-accredited programs.

The CP3R reports aggregate system-level data for Legacy Cancer Institute, as well as hospital specific data, regarding patient treatment and outcomes for patients with bladder, breast, cervical, colon, endometrial, gastric, kidney, lung, ovarian and rectal cancers.

For patients diagnosed in 2016, the latest available NCDB data set, Legacy continued to meet and exceed all breast cancer quality measures. Accountability measures of radiation administration for breast conservation or mastectomy patients and aromatase inhibitor consideration were 94.7-97.9% (benchmark of 90%), exceeding rates across the state and among all CoC programs. The quality measure of needle biopsy was 87.8%, exceeding the benchmark of 80% (See Figure 1, CoC NCDB CP3R 2016 — Legacy Health Breast Select Measures).

FIGURE 1, CoC NCDB CP3R 2016 — Legacy Health

Breast Select Measures	Measure	CoC Std/%	2016
Radiation is administered within 1 year (365 days) of diagnosis for women under the age of 70 receiving breast conservation surgery for breast cancer (Accountability)	BCSRT	4.4/90%	97.9%
Tamoxifen or third generation aromatase inhibitor is recommended or administered within 1 year (365 days) of diagnosis for women with AJCC T1c or Stage IB-III hormone receptor positive breast cancer (Accountability)	HT	4.4/90%	97.5%
Radiation therapy is recommended or administered following any mastectomy within 1 year (365 days) of diagnosis of breast cancer for women with ≥ 4 positive regional lymph nodes (Accountability)	MASTRT	4.4/90%	94.7%
Image or palpation-guided needle biopsy to the primary site is performed to establish diagnosis of breast cancer (Quality Improvement)	nBx	4.5/80%	87.8%
Combination chemotherapy is recommended or administered within 4 months (120 days) of diagnosis for women under 70 with AJCC T1cN0, or Stage IB - III hormone receptor negative breast cancer (Accountability)	MAC	Not Applicable	96.4%

Benchmark measures for patients with non-small cell lung cancer have been established at 85%. One hundred percent of lung cancer patients with resectable lymph node-positive disease were

considered for chemotherapy and nonoperative treatment in 90.9% of N2M0 Stage III lung cancers (see Figure 2, CoC NCDB CP3R 2016 — Legacy Health).

FIGURE 2, CoC NCDB CP3R 2016 — Legacy Health

Lung Select Measures	Measure	CoC Std/%	2016
Systemic chemotherapy is administered within 4 months to day preoperatively or day of surgery to 6 months postoperatively, or it is recommended for surgically resected cases with pathologic lymph node-positive (pN1) and (pN2) NSCLC (Quality Improvement)	LCT	4.5/85%	100%
Surgery is not the first course of treatment for cN2, M0 lung cases (Quality Improvement)	LNoSurg	4.5/85%	90.9%

The latest CP3R data also measures performance rates for two colon and one rectal measure. We have collected at least 12 lymph nodes with 94.2% of colon specimens, meeting the 85% benchmark, exceeding the rates of the rest of CoC programs, which are 92–93% locally and nationwide. We exceeded the benchmark with 88.5% of Stage III

colon cancer patients considered for chemotherapy. Preoperative radiation/chemotherapy was considered for 100% of locally advanced rectal cancers; another benchmark which exemplifies our ability to outperform other CoC programs in Oregon, our Pacific Northwest region and the nation.

FIGURE 3, CoC NCDB CP3R 2016 — Legacy Health

Colon & Rectum Select Measures	Measure	CoC Std/%	2016
At least 12 regional lymph nodes are removed and pathologically examined for resected colon cancer (Quality Improvement)	12RLN	4.5/85%	94.2%
Adjuvant chemotherapy is recommended, or administered within 4 months (120 days) of diagnosis for patients under the age of 80 with AJCC Stage III (lymph node positive) colon cancer (Accountability)	ACT	Not Applicable	88.5%
Preoperative chemotherapy and radiation are administered for clinical AJCC T3N0, T4N0, or Stage III; or Postoperative chemotherapy and radiation are administered within 180 days of diagnosis for clinical AJCC T1-2N0 with pathologic AJCC T3N0, T4N0, or Stage III; or treatment is recommended; for patients under the age of 80 receiving resection for rectal cancer (Quality Improvement)	RECRCT	4.5/85%	100%

Treatment of patients with gastric cancer is also assessed by the CP3R, which includes lymph node resection with the stomach specimen (at least 15 LNs). Our rate continues at 100%, exceeding

the baseline standard of 80% (See Figure 4, CoC NCDB CP3R 2016 — Legacy Health Gastric Select Measures).

FIGURE 4, CoC NCDB CP3R 2016 — Legacy Health

Gastric Select Measures	Measure	CoC Std/%	2016
At least 15 regional lymph nodes are removed and pathologically examined for resected gastric cancer (Quality Improvement)	G15RLN	4.5/80%	100%

Cervical, ovarian, endometrial, kidney and bladder measures are also collected and contributed to the national database, but no benchmarks have yet been established.

The NCDB also provides information for the ACS Cancer Quality Improvement Program (CQIP). CQIP is a data-driven, process and outcomes-based cancer quality improvement initiative that confidentially reports to 1,500 individual CoC-accredited hospitals. Their data is entered into NCDB, including comparisons with national data from all CoC-accredited programs. Measures include those captured in CP3R, as well as various other measures

and reports. Updated Legacy breast, colon and rectal cancer quality outcomes percentages continue to be consistently higher than average rates across Oregon and the nation.

Legacy Cancer Institute's comprehensive, community-based cancer program reflects an integrated team of physicians, staff and administrators dedicated to serving our patients. We again overall meet or exceed the cancer care quality benchmarks and will continue working to identify opportunities to optimize patient care through our partnership with the CoC.

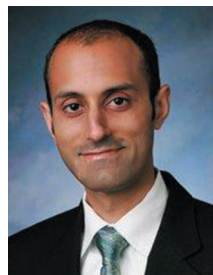
Surgical management of brain and spinal tumors (CNS tumors)

By Brian Ragel, M.D., FAANS, medical director, Legacy Brain and Spinal Tumor Program, Legacy Cancer Institute, neurosurgery, Rebound Orthopedics and Neurosurgery
Ashok Modha, M.D., neuro-oncologist and neurosurgery, Rebound Orthopedics and Neurosurgery

In the United States, an estimated 1.7 million new diagnoses of cancer are expected in 2019. Central Nervous System (CNS) tumors range from benign to malignant and can occur in the brain or spinal cord. Estimates for 2019 for new brain metastasis, spine metastasis and primary brain tumors are approximately 200,000, 125,000 and 24,000, respectively (Figure 5).



Estimates for 2019 for new brain metastasis, spine metastasis and primary brain tumors are approximately 200,000, 125,000 and 24,000, respectively (Figure 5).



The American Cancer Society estimates that approximately 18,000 people in the United States will die of primary brain cancer, and that the number of deaths will be higher when including deaths from metastatic brain and spine cancer are included (Figure 5). Interestingly, primary brain tumors account for only 1% of new cancer diagnoses, but 3% of all cancer deaths, underscoring the poor prognosis of primary brain tumors. In general, brain tumors present with seizure, headache and neurologic deficit, whereas spine tumors present with back pain, ataxia and/or paraparesis.

All brain and spinal tumors share a common goal of surgical management — to balance the extent of resection with the avoidance of permanent neurologic deficit. The phrase “safe maximal resection” was coined to convey this balancing act between tumor removal and neurologic deficit. For brain tumors, the general surgical indications are described as the four Ds: Diagnosis; improve or prevent neurologic Deficit; prevent Death; and obtain necessary tissue for clinical Drug trials.

For spine metastases, the four Ds remain surgical indications, but there is additionally consideration of spine stability, which is guided by the principles of decompressing the spinal cord and stabilizing

the spine. The risk of surgical neurologic deficit increases with tumors in or near the spinal cord and those in regions of the brain that control language (left temporal lobe), motor (posterior frontal lobe), vision (occipital cortex) and neurocognitive (hippocampal and deep brain structures) function. Other challenges of treating CNS tumors include the blood–brain barrier (BBB), which chemotherapies have difficulty crossing, and radiotherapy has limitations due to brain and spinal cord radiation damage.

This article reviews the surgical management of the top four cancerous tumors encountered in the brain and spinal column: metastatic brain, metastatic spine, meningiomas and high-grade gliomas (Figures 5 and 6).

Metastatic tumors are the most common CNS tumor type. Metastatic cancer to the brain may be slightly more common than that to the spine. The number of cancer patients developing brain metastasis is estimated to be between ~200,000–300,000 annually. Autopsy studies show that 25% of cancer patients have brain metastasis at death. Eighty percent of all cancers can metastasize to the brain, with lung, breast, melanoma and colorectal accounting for approximately 45%, 15%, 10% and 5% of brain metastases, respectively (Figure 8).

More than 80% of brain metastases are located in the cerebral hemispheres, at the gray matter–white matter junction, where small tumor cells can get trapped in intracranial arteries of decreasing diameter (Figure 8B). At presentation, over 50% of patients have multiple brain metastases. Trials from the Radiation Therapy Oncology Group (RTOG) show median survivals ranging from 2.3 to 7.1 months, depending on age, Karnofsky Performance Status (KPS) and systemic disease. Once diagnosed, brain metastases are usually the life-limiting component of the patient’s overall cancer burden.

Treatment options for brain metastases include glucocorticoids, chemotherapy, whole-brain radiation, stereotactic radiosurgery and/or surgical excision. Without treatment, survival can be as little as four weeks, increasing to eight weeks with high-dose glucocorticoids (e.g., dexamethasone). Radiation treatment can improve survival for three to six months with radiosensitive tumors responding quickly enough to negate surgery (e.g., small cell cancer of the lung, germ cell tumors, multiple myeloma, leukemia, and lymphoma). For others, surgical excision followed by radiation therapy for both single and multiple metastases can lead to a median 10 to 14 months of survival. Stereotactic radiosurgery appears to have similar results.

The surgical indications for brain metastasis are individualized but usually fall within the 4Ds. Large metastatic lesions (>2.5 cm) are more likely to be symptomatic by causing mass effect and mid-line shift (Figure 8). Some metastases incite peritumoral cerebral edema that may worsen with radiation, causing increased symptoms or even become life-threatening. In general, solitary and multiple metastases can be safely excised in patients who are good surgical candidates (e.g., no bleeding dyscrasias, no significant cardiac disease, no significant respiratory disease). Finally, surgical excision may be necessary after failure of radiation therapy or stereotactic radiosurgery.

Spinal epidural and vertebral body metastases are found in 5–10% of all patients with cancer, giving an annual estimated number of cases between approximately 90,000 and 175,000 (Figure 5). The cancers that mostly commonly metastasize to the spine are breast, prostate, lung and renal cell cancer, of which 73%, 68%, 36%, and 35% of cases will experience spine metastasis, respectively. The majority of metastatic spine cancers start in the vertebral body and expand to compress the epidural space, explaining why 20% of patients present with symptoms of back pain and/or motor weakness (e.g., paraplegia). Previous studies have shown that surgery to restore the ability to walk improves survival and pain control in such patients (median survival time 126 days vs. 100 days, pain control 90% vs. 70%).

Surgery for metastatic spine disease involves circumferential spinal cord decompression with or without spine stabilization to alleviate pain and/or prevent or restore neurologic deficit (Figure 9). It is hampered by a potential for high blood loss requiring transfusion, a long hospital stay, and up to eight weeks of recovery from surgery-related pain. In general, the goals of surgical intervention are to decompress the spinal cord to restore neurologic function and to stabilize pathologic fractures with instrumentation or vertebroplasty (i.e., methylmethacrylate bone cement) (Figures 9E, 9F). However, surgical morbidity can be as high as 50%.

When faced with a patient with metastatic spine disease, surgeons must weigh surgical morbidity, mortality and recovery time with the chances of improving neurologic function, decreasing pain and restoring spine stability. Surgical decision-making is done in the context of a patient who may not survive surgery or whose life expectancy may be shorter than the expected recovery time. The authors favor using the Spine Instability Neoplastic Score (SINS) to aid in surgical decisions. This scoring system gives an idea of spine stability, aiding in overall surgical decision-making.

Meningiomas are the most common primary central nervous system tumor, accounting for roughly 36% of all primary adult intracranial tumors (Figures 5 and 10). These tumors arise from cells within the dural covering of the brain and usually grow in an extrinsic fashion. Most meningiomas occur in patients 50–60 years of age, with a twofold higher incidence in females.

The biological behavior of meningiomas is one of continued growth, leading to compression of neuronal structures. Surgery is the treatment of choice and is frequently unsuccessful in treating these tumors. There are usually two reasons that this is not possible. First, the tumor location or its proximity to neurovascular structures may make complete resection impossible. Secondly, the inherent biology of the tumor may give a particular meningioma an increased chance of recurrence despite complete resection. Fortunately, histologically “atypical” or “malignant” tumors comprise of less than 10% of meningiomas. These two types of tumors are especially disposed to recurrence.

Surgery is favored for symptomatic meningiomas, whereas asymptomatic meningiomas may be monitored with serial imaging. The Simpson Classification is the most well-known scale used for the prediction of tumor recurrence after resection. The extent of resection, according to the Simpson Classification system, ranges from Grade 1 (complete resection) to Grade 5 (decompression only). After a macroscopically complete resection (Simpson Grade 1), the 5-, 10- and 15-year recurrence-free rates were 93%, 80% and 68%, respectively. For incompletely resected lesions (Grade 2–5), the progression-free rates at the same postoperative intervals were expectedly lower, at 63%, 45% and 9%, respectively.

Treatment options for recurrence or incomplete resection include further surgery, conventional external beam irradiation, stereotactic radiosurgery and systemic therapies. Most patients with malignant meningiomas will receive radiation therapy after surgery; however, radiation therapy or stereotactic radiosurgery are limited by radiation neurotoxicity, tumor size and injury to adjacent vascular or cranial nerves. To date, adjuvant chemotherapies have proven to be ineffective in controlling recurrent meningiomas.

High-grade gliomas (i.e., astrocytoma WHO grades III and IV, oligodendroglioma WHO grade III) represent approximately 25% of all primary brain tumors and are the most common intrinsic brain tumor (Figure 7, Figure 10B). These tumors are among the most difficult to treat. Despite advances in surgery, radiation and chemotherapy, the median survival after diagnosis of the most aggressive astrocytoma, glioblastoma (WHO grade IV), remains poor at approximately 12–14 months, with only 3–5% of patients surviving longer than five years. Glioblastoma can occur as the result of progression from lower-grade astrocytomas (i.e., WHO Grade II or III) or can arise *de novo*. Initial neurologic symptoms are seizure, headache and new neurologic deficit. Without treatment, survival is typically three

months. Treatment involves a combination of surgery for “safe maximal resection,” radiation therapy and the oral chemotherapy, temozolomide.

The goals of surgery are to obtain diagnostic tissue for both diagnosis and prognostication, to alleviate symptoms related to mass effect, to diminish tumor burden via cytoreduction and to decrease long-term steroid use. Surgery for high-grade gliomas involves balancing our goal of “safe maximal resection” of the tumor and avoiding a new neurologic deficit. Surgical techniques for increasing extent of resection involve the use of advanced magnetic resonance imaging (e.g., functional MRI), intraoperative microscope, stereotactic navigated instruments for resection, intraoperative imaging, intraoperative mapping and monitoring of language and motor pathways, and awake craniotomy for speech preservation in cooperative patients. Although studies have shown improved survival with >98% resection (median survival 13 months vs. 8.8 months), patient death may be hastened if patients are left with a profound neurologic deficit and reduced quality of life. After surgery, patients will undergo radiation and chemotherapy (i.e., temozolomide). Future hope also lies in individualized cancer care with new targeted therapies (e.g., molecules inhibitors, immunotherapy, conjugated antibody chemotherapy).

The surgical management of CNS tumors revolves around the concept of “safe maximal resection.” Surgical indications are defined by the need for diagnosis; improvement or prevention of neurologic deficit, prevention of death and/or the need to obtain tissue for clinical drug trials, as well as consideration of spine stability in the case of spinal tumors. The risk of surgical neurologic deficit increases with tumors in or near the spinal cord for language (left temporal lobe, usually), motor (posterior frontal lobe), vision (occipital cortex) and neurocognitive (hippocampal and deep brain structures) centers.

Acknowledgements

We thank Kristin Kraus for editorial assistance in preparing this article.

FIGURE 5, Estimated cancer statistics in the United States (U.S.) for 2019

Cancer cases	Estimated new 2019 (%)	Estimated deaths 2019 (%)
All sites cancer	1,762,450	606,880
Brain and other nervous system	23,820 (1%)	17,760 (3%)
Brain metastases occur in 6–14% of cancer patients	105,747–246,743 (1,762,450 × 6 and × 14%)	
Spine metastases occur in 5–10% of cancer patients	88,123–176,245 (1,762,450 × 5 and × 10%)	
Meningiomas occur in 37% of all primary SPINAL tumors	8,813 (23,820 × 37%)	
Malignant, High-grade Glioma occur in 24% of all primary SPINAL tumors.	5,716 (23,820 × 24%)	

Primary brain tumor estimates from American Cancer Society.¹ Metastatic brain, metastatic spine, meningiomas, and malignant high-grade glioma estimates extrapolated from published rates of occurrence.^{3,4,7}

FIGURE 6, Top 4 primary central nervous system tumors for 2011–2015

CNS tumor	%
Non-malignant meningioma	36.7%
Malignant high-grade glioma (e.g., glioblastoma, oligodendroglioma)	24.9%
Non-malignant pituitary tumors	16.4%
Non-malignant nerve sheath tumors (e.g., acoustic neuroma)	8.5%

(Note: Includes both non-malignant and malignant tumors, n = 392,982).³

FIGURE 7, Low and high-grade gliomas based on World Health Organization (WHO) classification 2,3,12–14

Pathology	WHO grade	Mean age (yr)	M:F ratio	Mean survival (yr)	Mean time progression (yr)	Notes:
Diffuse astrocytoma	II (LGG)	34	1.18 : 1	6–8	4–5	
Anaplastic astrocytoma	III (HGG)	51	1.31 : 1		2	
Glioblastoma	IV (HGG)	61	1.26 : 1	1		MGMT silencing and mutated IDH-1 associated with longer survival ^{12–14}
Oligodendroglioma	II (LGG)	40–45	1.1 : 1	11–15		1p/19q loss is associated with longer survival ¹¹
Anaplastic oligodendroglioma	III (HGG)	45–50	1.1 : 1	3.5		1p/19q loss is associated with longer survival ¹¹

Key: LGG = low-grade glioma, HGG = high-grade glioma, IDH-1 = isocitrate dehydrogenase 1 gene, MGMT = methyl-guanine-methyl-transferase

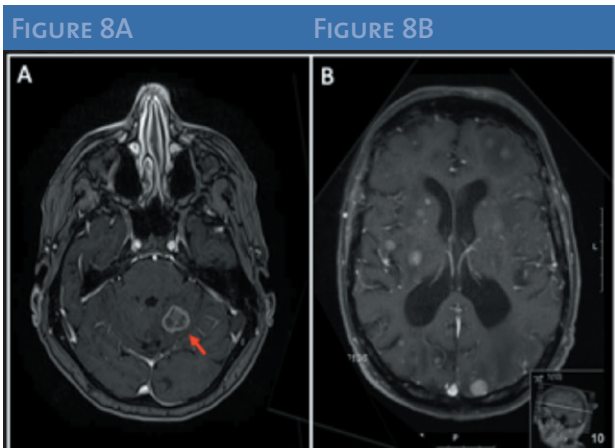


Figure 8: Brain metastases are the most common brain tumor. A. Axial T1-weighted magnetic resonance imaging (MRI) scan with contrast of patient with colorectal cancer and solitary metastasis to the left cerebellar brain (arrow). Mild edema causing mass effect on the fourth ventricle noted. B. Axial T1-weighted MRI scan with contrast of patient with lung cancer and multiple brain metastases scattered throughout the frontal, parietal and occipital lobes.

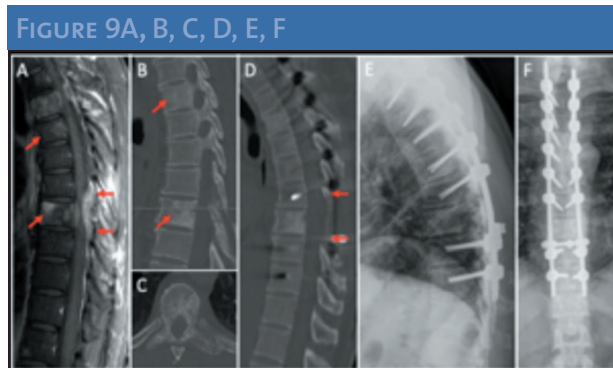
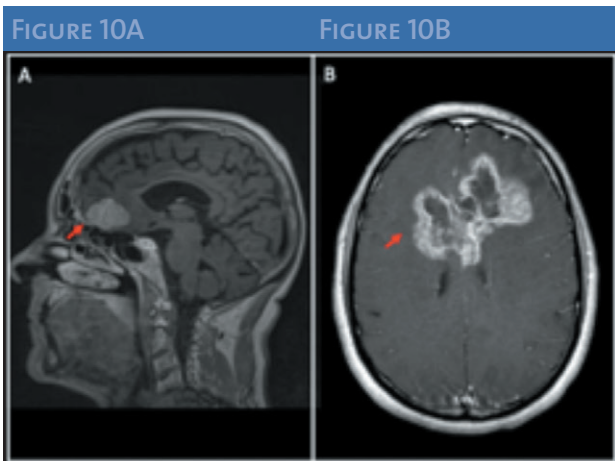


Figure 9: Imaging of a 52-year-old male patient presenting with paraplegia from metastatic prostate cancer to the thoracic spine with epidural spinal cord compression (A–C) treated with thoracic laminectomy and stabilization (D–F). A. Sagittal T1-weighted magnetic resonance imaging (MRI) scan with contrast. Arrows identify metastatic cancer to vertebral bodies and epidural space. B–C. Sagittal (B) and axial (C) computed tomography (CT) scans depicting osteoblastic response to metastatic prostate cancer. D. Postoperative sagittal CT with arrows indicating extent of laminectomy bone removal. E–F. Lateral (E) and anteroposterior (F) X-rays showing long-segment pedicle screw–rod construct for stabilization.

Figure 10: Magnetic resonance imaging (MRI) showing the two most common primary SPINAL tumors: meningioma and glioblastoma (GBM). A. Sagittal T1-weighted MRI scan with contrast with arrow showing a dural-based, extrinsic to the brain. The imaging is consistent with olfactory groove meningioma. B. Axial T1-weighted MRI scan with contrast of GBM (astrocytoma, WHO Grade IV).

Latest techniques in imaging

By Jeffrey Cagley, M.D., neuroradiologist, Diagnostic Imaging NW

Contrast-enhanced magnetic resonance imaging (MRI) remains the workhorse for brain and central nervous system tumor imaging, and modern scanning equipment allows for a



level of resolution and anatomic definition that allows the surgeon to maximize tumor resection while allowing for preservation of the critically important regions of the brain.

When evaluating intracranial neoplasms, ensuring the use of MRI scanners with 3 Tesla magnet strength allows for optimal signal and image resolution. 3D-acquisition techniques for post-contrast and fluid weighted (T2 FLAIR) sequences will allow for the highest resolution assessment of affected anatomic structures and visualization of the earliest signs of tumor progression or recurrence.

Though a multitude of tumor types are encountered by the radiologist, gliomas — namely astrocytoma, oligodendroglioma, and glioblastoma — remain some of the most diagnostically challenging entities to assess. One of the greatest difficulties in imaging these tumor types are the often subtle and innocuous imaging findings associated with disease progression.

The diagnostic complexity increases as many of these tumors undergo post-treatment pseudo-progression, which can closely mimic true disease progression. Despite continued imaging advances, pseudo-progression still occasionally results in unnecessary repeat surgeries despite the best judgment of qualified radiologists and neurosurgeons.

With the creation of the new World Health Organization 2016 guidelines for central nervous system tumors, the radiologist has been given a powerful new tool to aid evaluation of glioma — molecular markers. The two most radiologically important markers in the setting of gliomas are isocitrate dehydrogenase (IDH) and O6-methylguanine-DNA methyltransferase (MGMT). IDH tumor status directly correlates with survival, as IDH wild type

(non-mutated) tumors are associated with poorer outcomes. For example, lower-grade IDH wild-type tumors act more like high-grade tumors. Because of this, the threshold for calling radiologic progression of an IDH wild-type tumor should be much lower than that of an IDH mutated tumor.

MGMT methylated tumors, on the other hand, are associated with better survival and better response to therapy and are often associated with pseudo-progression. A practical clinical example: For a radiation-treated MGMT methylated glioma that shows early post-treatment enhancement on MRI, pseudo-progression should be strongly considered, and watchful waiting may be the appropriate course of action, delaying or potentially negating the need for an unnecessary surgery.

MR perfusion remains the most studied and valuable adjunct imaging technique for assessing intracranial neoplasms, especially gliomas. MR perfusion is a method for quantitatively and qualitatively assessing the temporal nature of blood flow and enhancement of the brain. Perfusion, in concert with molecular marker status, is the radiologist's most powerful tool for differentiating true tumor progression from pseudo-progression.

MR spectroscopy, which can non-invasively assess the chemical composition of tissue, remains another tool for differentiating tumor from non-tumoral tissue, though this has varying degrees of success in practice. Functional MRI is a powerful tool that allows for anatomic mapping of functionally significant regions of the brain (speech, memory, etc.) and allows the surgeon the highest degree of intraoperative certainty that he or she is avoiding these eloquent regions.

Together, the use of these modern advanced imaging techniques allows the radiologist to relay the highest quality diagnostic information to the treating neurosurgeon, radiation oncologist and medical oncologist, which in turn maximizes treatment outcomes for the patient.

Molecular diagnosis of brain tumors

By Zhuang Feng, M.D., Ph.D., molecular pathologist, director, Molecular Laboratory, Cascade Pathology Services

For a long time, the classification of brain tumors has been based largely on histological features. The characterization of such histological features has



been determined by microscopic findings in H&E-stained sections and immunohistochemical stains. The 2016 World Health Organization (WHO) Classification of Tumors of the Central Nervous System incorporates molecular parameters

into the classification of brain tumors in addition to histology and redefines brain tumor diagnoses in the molecular era. The integration of histological and molecular parameters into brain tumor classification adds an extra layer of objectivity, which in turn will render biologically more homogeneous diagnoses, obtain more precise prognosis and therapy, and improve patient care.

Glioblastoma is divided into glioblastoma, IDH-wildtype; glioblastoma, IDH-mutant; and glioblastoma, NOS. Glioblastoma, IDH-wildtype, comprises approximately 90% of cases, and presents generally as primary or de novo glioblastoma in older patients over 55 years of age. In contrast, glioblastoma, IDH-mutant, comprises about 10% of cases, and presents generally as secondary glioblastoma with a prior history of lower grade diffuse glioma in younger patients. Glioblastoma, NOS, is a diagnostic category that is reserved for the tumors for which a full IDH evaluation cannot be performed. The choice of a full IDH evaluation depends on patients and tumor characteristics. For glioblastoma in older patients over 55 years of age, the near absence of non-R132H IDH1 and IDH2 mutations suggests that sequencing of IDH1 R132 and IDH2 R172 codons may not be needed in the presence of negative IDH1 R132H immunohistochemistry. For glioblastoma in younger patients, as well as WHO grade II and III diffuse gliomas, sequencing of IDH codons

is highly recommended following negative IDH1 R132H immunohistochemistry. The diagnosis of oligodendroglioma and anaplastic oligodendroglioma requires the demonstration of combined IDH mutation and 1p/19q codeletion. Sequencing of IDH codons is also recommended following negative IDH1 R132H immunohistochemistry.

The integration of phenotypic and genotypic parameters promotes especially refinement of the diagnosis of oligoastrocytoma, a biologically heterogeneous entity with less defined histological features and high interobserver discordance. As a result, the vast majority of these tumors can be classified as more common types, either astrocytoma (IDH-mutant, ATRX-mutant, 1p/19q-intact) or oligodendroglioma (IDH-mutant, ATRX-wildtype, 1p/19q-codeleted). The diagnosis of true oligoastrocytoma consisting of histologically and genetically distinct astrocytic and oligodendroglial components is thus becoming rare with the advent of molecular testing.

It is important to acknowledge that such changes in the classification may pose challenges in testing and reporting. These challenges may include the availability, choice and turnaround time of molecular testing and/or surrogate immunohistochemistry, the format and time allocated to report the integrated diagnoses. These integrated diagnoses require standardization of terminology in a practical and informative manner.

In summary, the new classification presents major refinement of diagnoses for some brain tumors, by combining histological and molecular features. While this change has introduced challenges, it brings objective measures that will more precisely define diseases, improve the lives of patients and facilitate clinical and basic studies in the future.

Genetics in brain and spinal tumors

By *Therese Tuohy, Ph.D., certified genetics counselor, Legacy Cancer Institute*

The lifetime risk for a malignant CNS tumor in the US is about 1/165, with an annual incidence of ~24,000. However, the mortality rate is high, with about ~18,000 annual deaths.



Although usually sporadic, a subset of central nervous system (CNS) neoplasms arise in the context of germline mutations in genes associated with tumor syndromes. Currently, clinical genetic testing panels

allow for individual or combined analysis of up to ~25 genes currently known to be associated with inherited predisposition to CNS tumors of the central nervous system. Most of these mutations are inherited, but *de novo* mutations have been reported in up to 20% of cases, especially with recent increased access to germline testing based on personal risk, in the absence of strong family history.

Neurofibromatosis type 1 (NF1) is the most common of these conditions, affecting about 1/3,000 in the general population and is associated with CNS tumors with up to ~20% risks for schwannomas, meningiomas and gliomas; unlike most genetic syndromes, the clinical features of NF1 usually make molecular testing unnecessary for diagnosis. Fortunately, most of these tumors spontaneously regress between childhood and adulthood. Neurofibromatosis type 2 (less than 10 times as common) almost always leads to bilateral vestibular schwannomas, but also has high risks for meningiomas and spinal cord ependymomas. People with tuberous sclerosis (TSC1 and TSC2) have a ~20% risk of subependymal giant cell astrocytomas (SEGAs).

Some of these genes are primarily associated with CNS tumors but most are primarily associated with risks for cancers of other tissues, with lesser, but nevertheless higher-than-population, risks for CNS tumors. For example, Lynch syndrome genes (MHL1, MSH2, MSH6, PMS2 and EPCAM) are primarily associated with increased risks for colorectal and gynecologic cancers but are also associated

with up to 4% lifetime risk of brain tumors, mostly gliomas. Similarly, familial adenomatous polyposis (due to APC mutations) carries a risk of up to ~1% risk for brain tumors, mostly medulloblastomas. Pilocytic astrocytomas, glioblastomas and medulloblastomas have all been reported, albeit rarely, in association with germline ATM mutations, which are found up to 3% of the general population. Von Hippel-Lindau (VHL) patients often develop hemangioblastomas in the brain and spinal cord and Li-Fraumeni syndrome (TP53) most often increases the risks of breast cancer, soft tissue sarcomas, leukemia and adrenal gland cancer, but also gliomas and astrocytomas.

Traditional painstaking evaluation for the relevance of genetic testing has been eclipsed by the ready availability of comprehensive genetic testing panels, and affordability is increasingly more attainable, especially in the context of the costs of clinical management for cancer management. Pretest counseling for gene-specific risks, and consideration of genetic privacy and insurability can benefit patients by facilitating strategic long-term planning for them and their families. This is especially important for clinically unaffected at-risk family members. Post-test coordinated management for multiple-risk screening and periodic updates of rapidly evolving information helps patients and their families navigate this new territory.

Legacy currently diagnoses about 100 CNS cancers annually and provides care to about 100 additional patients diagnosed elsewhere. As up to ~10% of these may have a previously unrecognized inherited predisposition, each of those 20 patients can benefit not only themselves, but their first- and second-degree relatives by having risk evaluation to facilitate early detection, when a cure is most likely. For information about the Legacy Genetics Counseling program, please call 503-413-6534.

The value of genomic profiling in brain tumors

By Yasmine Akkari, Ph.D., FACMG, scientific and technical director, Cytogenetics Services and Molecular Pathology, Legacy Health

In the current era of personalized medicine, genomic profiling of brain and spinal tumors has gained much attention in the recent years in an



effort to improve outcomes and provide targeted therapies. Despite many advances in cancer treatment, these tumors remain difficult to treat based on their suboptimal response to conventional therapies.

Brain and spinal tumors often lead to neurocognitive deficits necessitating a novel approach to both management and treatment of these tumors. Moreover, advances of genomic technologies, the current World Health Organization (2016) reclassification of central nervous system gliomas based on combination of molecular and histological data, and the knowledge that chromosomal aberrations drive tumorigenesis have all led to an increase in the value of genomic profiling in these tumors (genomic profiling is described throughout this article to include analysis of DNA copy number aberrations, structural chromosomal rearrangements and single nucleotide variants) (Dubuc and Ligon, *Curr. Genet. Med. Rep.* 2017). In this article, we discuss some of the most common pediatric and adult brain and spinal tumors in which genomic profiling have benefits for diagnosis and prognosis, as well as treatment options.

Clinical presentation of these tumors depends of the location of the lesion. General signs and symptoms include headaches, seizures, visual changes, loss of appetite, nausea and vomiting, as well as changes in personality, mood, mental capacity and concentration.

The most common pediatric brain tumors are medulloblastomas, which are embryonal tumors that present with Homer Wright rosettes on histological examination. Data from expression array-based analyses have classified medulloblastoma into four distinct molecular subgroups (Eberhart CG, *Cancer Cell* 21, 2012). The first group, called WNT group (prevalence of 7–8%), shows classic histology and a very good outcome. Although loss of chromosome 6 has been commonly observed in this group, it does not confer an independent prognostic factor.

The second group, the SHH group, is more common (28 to 32%), shows desmoplastic/nodular histology and confers a good to intermediate prognosis. The presence of GLI2 and MYCN amplification as well as loss and/or chromothripsis (i.e. chromosome shattering) of chromosome 14q is associated with worse survival.

The third group, group 3 (prevalence of 27%), shows large cell/anaplastic histology and confers a poor prognosis. Genomically, the presence of iso17q (loss of short arm of chromosome 17) and MYCN amplification identifies high-risk patients in this group. The fourth group, group 4, is the most common (34 to 38%), shows classic histology and has an intermediate outcome depending on genomic findings. Loss of chromosome 11 or gain of chromosome 17, in addition to 10p loss, exhibit better survival. It is worth noting that the more generic names of group 3 and group 4 were thought to be most appropriate until the biology of these subgroups is better understood (Shih DJH et al., *J. Clin. Oncol.* 2014).

Perhaps the most recently studied molecular classification of pediatric brain tumors are ependymomas. This classification is based on a multidisciplinary approach, including location, histology and genomic profiling (Pajtler KW et al., *Cancer Cell*, 2015). It has proven to be invaluable especially that ependymomas have high clinical variability in terms of predicting patient outcomes. The key molecular and clinical classification is divided by location into spine (SP-; chromosomal instability, and chromosome 6q deletions), posterior fossa (PF-; balanced chromosome rearrangements and instability), and supratentorial (ST-; YAP1 fusion, aberrations in chromosome 11q, and chromothripsis of chromosome 11 with the RELA fusion). Age and gender distribution in addition to patient survival have been described for each subgroup (Pajtler KW et al., *Cancer Cell*, 2015).

Conversely, the most common adult brain tumor is glioblastoma (GBM). These are aggressive and complex tumors that occur both in the adult and pediatric population. Diagnosis and management of GBM depends on several molecular markers. These include mutation status of the IDH1 and IDH2 genes which, when positive confer a better prognosis and renders the tumor more susceptible to oxidative damage. In addition, hypermethylation

of the MGMT gene promoter confers a good response to alkylating agents such as temozolomide. Other genomic aberrations include gain of chromosome 7, loss of chromosome 10 and amplification of the EGFR locus. Increased complexity of these tumors' genomes, especially gene amplification, is inversely correlated with survival (Gonzales-Tablas M et al. *Oncotarget*, 2018).

Other brain tumors that have benefited from genomic profiling include pilocytic astrocytoma with the BRAF/KIAA1549 gene fusion, rendering this group potentially sensitive to BRAF inhibitors, adult meningiomas where chromosomal profiling may clarify tumor grade and predict recurrence, and oligodendrogliomas with 1p/19q deletions.

In conclusion, many types of brain and spinal tumors, including the ones mentioned here, show molecular markers that not only help in their diagnosis and management, but also can offer alternative targeted therapies for better outcomes. Some of these tumors are associated with genetic predisposition syndromes. For a more detailed description of germline predisposition to brain and spinal tumors, please see the "Genetics in brain and spinal tumors" article by Therese Tuohy in this annual report.

Oncology clinical research — brain and spinal tumors

By Meg Christ, N.D., clinical research coordinator, Legacy Cancer Institute

The most common type of primary brain tumors in adults are meningiomas. The Central Brain Tumor Registry estimates 29,000 new cases per year in



the United States. Current treatment for grade II meningiomas is surgical resection, but there is a lack of consensus regarding if or when radiation should be administered following surgery. Surgery alone provides tumor control of about 70% at three

years, and any potential side effects of radiation are avoided. Adding post-surgical radiation may improve the likelihood that the tumor does not recur by an additional 15% but may cause side effects.

NRG Oncology's BN003 trial, offered at Legacy Cancer Institute aims to help establish best practice recommendations for post-surgical care for these patients. Half of the patients are randomized to the surgery alone arm, and the other half receive both surgery and radiation therapy. The research base is working toward accruing 133 patients to the study nationwide, and Legacy Oncology Research is fortunate to help them reach this goal.

The CE.7 trial, conducted by the Canadian Cancer Trials Group (CCTG), is for patients with brain metastases, also known as secondary brain tumors. These occur in 10–30% of adults with cancer. The usual

approach for people not in the study is treatment with whole brain radiation therapy (WBRT). This technique irradiates the entire brain, including both visible brain tumors and any microscopic brain tumors that are still invisible on imaging. This preventive approach is efficacious, but because normal, healthy brain tissue is also irradiated, alternatives are being considered. One of these alternatives is stereotactic radiosurgery (SRS), which targets only the visible areas of tumor in the brain and excludes the surrounding tissue. This procedure only takes one day instead of two weeks. It is an attractive option in reducing patient time spent at the clinic and potential side effects, but it is not yet known if it is as effective as WBRT. In 2019, Legacy Oncology Research will activate this study to offer to our patients. Our research staff and radiation oncologists are excited to be a part of this important trial.

Legacy Health continually seeks out clinical trials that provide patients with opportunities to participate in cutting-edge research. We are proud to work with our excellent physicians, the cooperative research groups, CCTG, the National Cancer Institute and industry sponsors to advance cancer treatment in our community now, and for the future. For more information about clinical trials offered at Legacy Cancer Institute visit legacyhealth.org/lciclinaltrials or call 503-413-8199.

Legacy Research Institute tumor bank

By Carmen Rusinaru, M.D., Ph.D., research laboratory supervisor, Legacy Research Institute

In 2002, the National Dialogue on Cancer identified limited access to “appropriately collected, consented and annotated tissue” as a critical barrier to developing new cancer therapies. The Legacy Tumor Bank was founded in 2006 to address this resource gap by storing frozen and paraffin-embedded tumor tissue.



Due to the outstanding support we have received from surgeons, pathologists and team members at the Legacy Cancer Institute, our collection has now grown to greater than 1,600 cases, including more than 130 samples from outside the Portland metropolitan area.

The Legacy Research Institute tumor bank continues to support the COC requirement for clinical research with contributions of tissue. In 2018, the tumor bank’s contributions helped the LCI meet the 8% commodation goal for research.

The use of biological samples is essential to study relevant biomarkers and biologic pathways for therapeutic drug and molecular genetic testing. Our robust collection of superior quality tumor samples allows researchers to determine the factors that lead to cancer in solid tumors, thus expanding Legacy’s presence in the health care and research communities.

Medical oncology for brain and spinal tumors

By Ted Huang, M.D., medical oncologist, OHSU Knight-Legacy Health Cancer Collaborative

As part of the OHSU Knight–Legacy Health Cancer Collaborative, medical oncologists from the Knight Cancer Institute are working closely with our Legacy neurosurgery and radiation oncology colleagues to provide the latest treatments for our cancer patients with brain and spinal tumors.



The backbone of treatment after surgery for primary brain tumors, such as astrocytoma and glioblastoma, remains oral temozolomide in combination with radiation therapy. Although newer molecular markers, such as methylguanine methyltransferase (MGMT) and isocitrate dehydrogenase (IDH-1) status, help predict overall progno-

sis and likelihood of response to treatment, it has not altered how we treat patients at this time.

Immunotherapy using checkpoint inhibitors, such as pembrolizumab, are showing greater promise and will hopefully be added to our current treatment options in the near future. There are also ongoing studies available here at Legacy Cancer Institute evaluating the role of targetable mutations in an attempt to further personalize cancer care for this population with limited treatment options.

Legacy Cancer Institute, with its multidisciplinary approach, state-of-the-art therapies, cross institutional collaboration and expanding clinical trial portfolio, provides our patients with the best available diagnostic, treatment and supportive therapy options.

Radiation treatment and the use of Gamma Knife in brain tumors

By Andrew Kee, M.D., radiation oncologist, Legacy Medical Group—Radiation Oncology

With an estimated ~200,000–300,000 cancer patients developing brain metastasis annually, significant resources have been allocated to research, and advancements are being made in the management of this disease. In an era of better imaging, targeted therapy and improved radiation delivery machines, the role of whole brain radiotherapy (WBRT) as initial therapy has diminished.



For Legacy Cancer Institute patients with a limited number and volume of brain metastasis, stereotactic radiosurgery (SRS), utilizing the Gamma Knife platform, remains the treatment of choice. Advantages include the significant reduction of radiation exposure to the surrounding normal brain and the convenience of a one-day treatment, which also allows for the immediate transition to systemic therapy with minimal, or no, scheduling delay. Since extracranial disease progression and its associated complications remain the most common cause of death for most patients with brain metastasis, timely initiation of systemic therapy remains a high priority in these patients.

Over the past five to 10 years, the therapy of choice for patients with four or more brain metastases has shifted away from WBRT. Prospective studies have also shown no survival difference between patients with two to four brain metastases and those with five to 10 metastases when treated with SRS using the Gamma Knife platform. There is also a suggestion of a survival advantage to SRS over WBRT in brain metastasis patients younger than 50 years old. Phase 3 randomized trials have shown WBRT patients were more likely to suffer cognitive

decline and a reduced quality of life, when compared to those patients treated with SRS alone.

In those patients whose only option is WBRT, advancements in treatment techniques have reduced the severity of neurocognitive decline. In a recent presentation by the lead authors of a Phase 3 study, hippocampal avoidance WBRT compared to standard WBRT showed a 26% relative reduction in neurocognitive decline. Another 22% relative reduction in neurocognitive loss with WBRT is found with the addition of a drug approved for Alzheimer's dementia, memantine. Thus, even as the role of WBRT diminishes for many patients, emerging evidence from randomized clinical trials is helping to reduce neurocognitive decline in those patients not appropriate for SRS.

There are multiple brain metastasis studies open at Legacy Cancer Institute. These include a Phase 3 randomized study comparing hippocampal avoidance WBRT with memantine versus Gamma Knife SRS for patients with five to 15 brain metastases, using preservation of neurocognitive function as the main endpoint. In addition, there is a brain metastasis velocity study, in which patients who suffer multiple recurrent brain metastases will be randomized between SRS and hippocampal avoidance WBRT. Lastly, a Phase 3 study adding lapatinib to Gamma Knife SRS for Her2neu positive brain metastasis arising from breast cancer is underway at Legacy Cancer Institute.

For patients stricken with primary glioma of the brain, it is imperative that treatments and techniques are developed to improve life expectancy and reduce the toxic effects of therapy. One of the more promising studies that will soon open at Legacy is a multi-institutional Phase 3 random-

ized study comparing standard of care surgery and post-operative chemoradiotherapy to injecting a viral vector directly into the tumor cavity during surgery, selectively targeting glioblastoma cells and delivering cytotoxic drug directly into the malignant cells. This will be followed by post-operative chemoradiotherapy.

There is a promising technology that may reduce the deleterious effects of radiotherapy on normal brain tissues. This costly technology delivers the radiation dose using protons, rather than the photons, which are the mainstay of current radiotherapy. Protons have the desirable physical property of ceasing to deposit radiation dose after a specified, and controllable, depth of normal tissue (Bragg peak). This results in a reduced radiation dose to those normal tissues lying beyond the target, when compared to photons. This property has generated significant interest in the treatment of pediatric brain tumors. Not only is the dose reduced to the tissues in the child's brain, which will continue to develop throughout childhood and beyond, but also may potentially reduce the risk of radiation-induced second malignancy during the greater expected post-treatment lifespan of a pediatric patient.

Because of the complexity involved in both creating clinically useful proton beams and the infrastructure required to do so safely, all the components to deliver proton radiotherapy are much larger and more costly, resulting in significantly increased costs to build and operate, as compared to a photon facility. Unfortunately, this poses great challenges in the current fiscal environment of medical care with several proton centers declaring bankruptcy. Currently, there are only 31 operational proton facilities nationally, with some facilities limited to specific disease sites. It is anticipated that nearly 40 centers will be operational within the next year or two. There is also a spectrum of proton technology currently in use at those centers. Some are using equipment that delivers radiation distributions, which are of equivocal value when compared to modern photon IMRT. As the Legacy/OHSU cancer collaborative continues to invest in new technology, we will always keep patient care as our top priority and only invest in equipment that will truly benefit our patients.

Ongoing quality improvement for the brain and spinal tumor program

By Mindy Ansteth, BS, CTR, manager, cancer data management and quality improvement consultant, Legacy Cancer Institute

Patient care is the focus of continuous quality improvement at Legacy Cancer Institute. Our quality improvement framework is based on providing patients the care they need, at the time they need it, and in a manner that is safe, effective and efficient. We hold ourselves accountable by regularly monitoring and benchmarking our performance, challenging the status quo and implementing the most current in clinical and operational best practices.



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The LCI Brain and Spinal Tumor Program Development Committee is comprised of a multidisciplinary team of clinicians, support services staff and LCI administration who discuss quality performance, barriers, quality improvements and the latest in evidence-based treatment guidelines and national benchmarking. Our quality improvement dashboard includes quality metrics that have a direct impact on patient outcomes and survival, timeliness of care and patient satisfaction. Our performance data is discussed, follow up actions are assigned, and a root cause analysis is performed as often as necessary.

The quality improvement dashboard has evolved along with the Legacy Brain and Spinal Tumor Program, and with the advances in treatment and genetic testing. In 2018, the dashboard was revised to include the following quality performance metrics:

- Documentation of Karnofsky Performance Status (KPS) in physician consult notes — KPS estimates prognosis, measures the efficacy of treatment, and is applied to cancer research to select and stratify patients for clinical trials.
- Cases presented at the monthly Legacy Brain and Spinal cancer conference (tumor board) — Multidisciplinary cancer conference discussions for patient treatment and care planning is associated with improved quality and coordination of care.

- Testing for combined loss of 1p/19q in gliomas with an oligodendroglial component — Combined loss of 1p/19q is an important positive biomarker of the disease and is associated with improved patient survival.
- Testing for MGMT promoter methylation status in glioblastomas — MGMT is a favorable prognostic factor and strong predictor of responsiveness to alkylating chemotherapy.
- Malignant gliomas with enhancing component on pre-operative imaging that undergo maximal surgical resection — Extensive surgical resection of the enhancing tumor component of the disease is associated with longer survival.
- Surgical malignant glioma patients receiving post-operative MRI within 48 hours of surgery— The extent of resection is strongly correlated with overall survival and many clinical trials include measures of residual disease as a criterion for inclusion.
- Surgical WHO grade III or IV glioma patients who undergo chemotherapy, radiation therapy or combination chemo/radiation therapy within four weeks of surgery — This treatment regimen is associated with improved survival and overall patient quality of life.

Meaningful performance metrics, data transparency and multidisciplinary team involvement drive our quality improvement efforts forward. Under the leadership of Brian Ragel, M.D., FAANS, medical director of Legacy Brain and Spinal Tumor Program; Alizah Rotramel, M.D., FACS, Legacy Quality Advisory Committee chair; and Nathalie Johnson, M.D., FACS, medical director, Legacy Cancer Institute and Legacy Breast Health Centers, the Legacy Brain and Spinal Tumor Program continues to uphold Legacy's longstanding commitment to continuous quality improvement and safe, patient-centered care.

Legacy Cancer Data Management — 2018 highlights

By Dawn Cox, CTR, supervisor, Legacy Cancer Data Management

Legacy Cancer Data Management (CDM) is essential to Legacy Cancer Institute. Data reporting to the Oregon and Washington state central cancer



registries is required by law and of cancer programs accredited by the American College of Surgeons (ACS) Commission on Cancer (CoC).

The repository of data reported to state central cancer registries is incredibly valuable to national and international organizations. It supports important cancer research, is used to evaluate the efficacy of treatment and to improve patient outcomes and survival. At Legacy, data is also used for various clinical and operational quality improvement dashboards for benchmarking and continual quality improvement efforts.

Legacy Cancer Institute was the first INCP in the nation to be accredited by the CoC and is the only INCP in the State of Oregon. Accreditation requires adherence to very specific accreditation standards to ensure data integrity and quality, and quality patient-centered care. The Cancer Data Management Team proudly exceeded all Cancer Data Management-specific accreditation standards in 2018, which include-

- Yearly patient follow-up rate of 96% for patients treated and diagnosed within the past five years. The COC standard is at least 90% for this sub-set of patients.
- Yearly patient follow-up rate of 92% for patients diagnosed from 1997 to 2013. The COC standard is at least 80% for this sub-set of patients.
- Monthly data submissions to the CoC Rapid Quality Reporting System (RQRS). RQRS is a real time data reporting tool for participating programs to monitor their adherence to specific evidence-based treatment guidelines and compare their performance to other CoC accredited programs nationally.

- Submitted over 2,700 cases to the CoC National Cancer Data Base as required by the CoC Annual Call for Data. All cases were submitted error free and rejection free.
- Completed all cancer data management continuing education requirements.
- Tracked, reported and monitored over 33 monthly cancer conferences to ensure adherence to multidisciplinary team attendance and various documentation requirements.
- Coordinated and completed the physician quality abstract review for over 10% of the eligible yearly analytic case volume.
- Completed an in-depth and detailed CoC Special Study, A Retrospective Comparison of Operative versus Medical Endocrine Therapy for Low-Risk Ductal carcinoma in situ (DCIS).

In 2018, Legacy Cancer Data Management was actively involved with the Oregon State Cancer Registrars Association (OCRA). One of our certified cancer registrars (CTR), served as OCRA Secretary. LCI Cancer Data Management Supervisor was actively involved with National Cancer Registrars Association (NCRA) and served on the NCRA Advanced Education Committee. The committee is responsible for developing educational webinars and resource materials to support cancer data management professionals in ongoing education and remaining current with the vast changes that continually impact the profession.

The release of the new eighth edition AJCC Staging Guidelines went into effect for newly diagnosed cancer cases as of January 1, 2018. The significant revisions to the guidelines reflect the most current evidence-based practices in cancer diagnosis and treatment. Legacy Cancer Data Management worked diligently to prepare for the significant and exciting changes in order to maintain our high level of professional expertise and reporting.

Monitoring compliance with evidence-based guidelines of brain and spinal tumors

By Brian Ragel, M.D., FAANS, medical director, Legacy Brain and Spinal Tumor Program, Legacy Cancer Institute, neurosurgery, Rebound Orthopedics and Neurosurgery

Ashok Modha, M.D., neuro-oncologist and neurosurgery, Rebound Orthopedics and Neurosurgery

In 1922, the American College of Surgeons established the Commission on Cancer (CoC) dedicated to improving both patient survival and quality of life by establishing guidelines that ensure patient-focused care through standard setting, prevention, research, education and monitoring. As part of this mission, the CoC maintains the *Cancer Program Standards: Ensuring Patient-Centered Care*, which establishes requirements for cancer program accreditation. Chapter 4 outlines standards for patient outcome tracking, which includes standard 4.6 ,



“Monitoring Compliance with Evidence-Based Guidelines,” which involves a case review to

assess if patient work up, evaluation and treatment are compliant with evidence-based treatment guidelines.

The Legacy Cancer Institute (LCI) endorses and follows the guidelines put forth by the National Comprehensive Cancer Network (NCCN), an alliance of 28 cancer centers devoted to patient care, research and education. NCCN publishes oncology guidelines for clinicians reflecting current cancer care. The NCCN Guidelines for Central Nervous System Cancers are level 2A recommendations (based on lower-level evidence, with uniform NCCN consensus that the intervention is appropriate). These guidelines reflect current World Health Organization (WHO) glioma classification based on histologic features and genetic alterations (Figure 11).

In 2018, physician members of the Legacy Integrated Network Cancer Committee analyzed 2016 analytic central nervous system

(CNS) cases to assess if patients with high-grade gliomas were treated according to the guidelines. We compared the cancer treatment of patients diagnosed and/or treated for anaplastic astrocytoma (AA), glioblastoma (GBM), or anaplastic oligodendroglioma (AO) at Legacy hospitals. High-grade gliomas carry a poor prognosis, with a median survival rate of approximately two, one and 3.5 years for AA, GBM and AO, respectively (Figure 11). Current treatment paradigms for high-grade gliomas consist of resection, radiotherapy and oral temozolomide chemotherapy treatment. We analyzed patients treated at LCI for these high-grade gliomas to ensure that our patients are receiving treatment in accordance with NCCN guidelines. The case review included the following-

- **Case presentation at the LCI multidisciplinary case conferences.** A growing body of literature is demonstrating that a team-based approach can reduce mortality, improve hospital management of medications and improve outpatient management. Cancer therapies continue to rapidly evolve with new genetic markers and treatments (small molecular inhibitors and antibody therapies)

FIGURE 11, 2016 World Health Organization classification scheme for high-grade gliomas⁴

WHO Grade	Tumor subtype
Astrocytoma, WHO Grade III	Anaplastic astrocytoma, IDH-mutant
	Anaplastic astrocytoma, IDH-wildtype
	Anaplastic astrocytoma, NOS
Astrocytoma, WHO Grade IV	Glioblastoma, IDH-wildtype
	Glioblastoma, IDH-mutant
	Glioblastoma, NOS
Oligodendroglioma, WHO Grade III	Anaplastic oligodendroglioma, IDH-mutant and 1p/19q-codeleted
	Anaplastic oligodendroglioma, NOS
	Anaplastic oligoastrocytoma, NOS

WHO = World Health Organization, IDH-1 = isocitrate dehydrogenase - 1, NOS = not otherwise specified.

changing patient care on almost a daily basis. Patient case discussion at multidisciplinary cancer conferences ensures oncologic, radiotherapy, radiographic and surgical opinions to ensure up-to-date care. The team-based approach has been shown to improve guideline compliance, follow-up, pain control, patient adherence to therapies and communication between health care professionals.

- **Documentation of Karnofsky Performance Score (KPS) in the patient medical record.** Because of the poor prognosis, standardizing patient care focuses on maximizing quality of life by offering all treatments to patients with high functional performance scores (i.e., KPS) and suggesting hospice care for patients with low initial functional performance scores. NCCN treatment pathways are dependent on initial patient function with aggressive treatments recommended for higher functioning patients and hospice suggested for patients with poor scores.
- **Pre-surgical MRI.** Pre-surgical MRI is a required component of the patient work up and evaluation.
- **Appropriate molecular and genetic testing.** Currently, MGMT and IDH-1 markers are being used to help prognosticate at LCI, but they are not used to change our standard high-grade glioma therapy pathway. Future genetic analysis will focus on targetable markers that indicate cancer susceptibility to new chemo- and biologic therapies, enabling targeted patient care. As a cancer institute, expanding our genetic marker profiling allows for the identification of cancer patients that may benefit from future therapies
- **Safe maximal tumor resection.** Surgical treatment of high-grade gliomas must balance efforts at achieving complete resection with the potential for devastating neurologic deficit — prompting the term “safe maximal” resection. In general, complete high-grade glioma resection can only increase survival by two months. In the end, surgery is not the complete answer for patients with high-grade gliomas; instead, new tumor-specific treatments are needed, guided by

genetic markers. Complete resection is based on size and location of the tumor (see example in Figure 12). Brain tumors adjacent or involving eloquent cortex have unacceptable surgical morbidity (devastating neurologic deficit) and are either watched, biopsied or undergo “safe maximal” resection.

- **Administration of adjuvant therapies in the form of radiation and chemotherapy offered in appropriate cases and administered when possible.**

This case analysis of the adherence to national guidelines regarding the best patient treatment pathway for high-grade gliomas found that patients treated at LCI are treated according NCCN Guidelines. Detailed results of the case review were shared with the LCI Integrated Network Network Cancer Committee, the LCI Neuro-oncology Program and attendees of the LCI Brain/CNS multidisciplinary cancer conference. As a result of this case review, a quality indicator was added to the Brain/CNS quality improvement dashboard to track the number of days from surgery to concurrent chemo/radiation for ongoing tracking and review. Discussions with Legacy laboratory and pathology departments about the ever evolving and expanding molecular and genetic testing are ongoing.

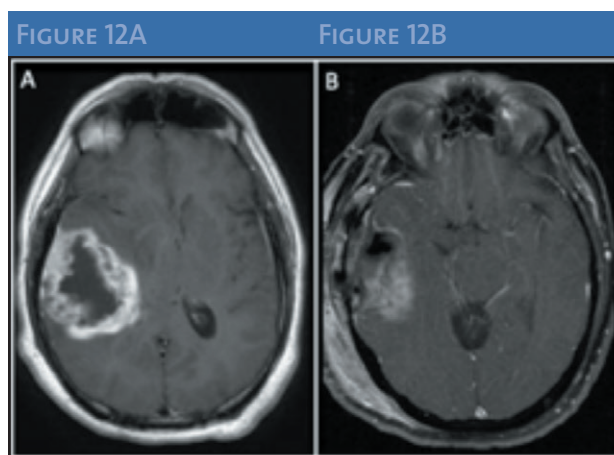


Figure 12. (A) Preoperative axial T1-weighted magnetic resonance imaging with contrast depicting a right temporoparietal lobe mass with imaging characteristics consistent with high-grade glioma. (B) Postoperative axial T1-weighted magnetic resonance imaging showing subtotal resection of tumor with residual in the posterior temporal region. The extent of resection was estimated at >90%.

Oncology nurse navigation program

By Annette Raab, R.N., OCN, oncology nurse navigator, Legacy Cancer Institute

Starting an oncology nurse navigation program in 2007 exemplifies Legacy Cancer Institute's long-standing commitment to serve as an early adopter



in the region. With partial funding from Legacy Foundations, the vision to implement a navigation program became a reality, and two oncology nurse navigators were hired at Legacy Good Samaritan Medical Center. Legacy became one of the first

hospital oncology navigation programs in the Portland metro area.

The navigation program has since expanded across the Legacy Health system. Although it has evolved from the original model, the goals remain the same — to facilitate care continuity, provide clinical support and education and address barriers to care for our patients. Growth can be measured by the different patient populations currently served by our navigation program. We now have a dedicated nurse navigator with extensive experience and knowledge of brain and spinal tumor diagnoses, treatment and health system operations. This focus and expertise contribute to improved cancer care experiences for our patients.

Getting diagnosed with a brain or spinal tumor often comes unexpectedly and is understandably overwhelming. Patients typically receive their diagnosis in an emergent situation and require immediate surgery. The stress and uncertainty can be profound for newly diagnosed patients and their loved ones. At Legacy, the Brain and Spinal Tumor Nurse Navigator is available to assist and support patients and their families as they navigate treatment.

Discussions and decisions about initiating adjuvant treatment, such as chemotherapy and/or radiation, typically takes place after surgery. The navigator plays a key role helping patients and families understand the diagnosis, treatment options and resources available while providing support and guidance through the continuum of cancer care.

Traditional brain and spinal cancer care can be quite complex, with treatment and visits potentially taking place in both the inpatient and outpatient settings. The navigator provides on-going reassurance and serves as a “point person” to help address health care system and individual barriers to care throughout the cancer care process. As an integral member of the multidisciplinary team and a key liaison for interdepartmental collaboration and communication, the navigator works closely with all members of the health care team to ensure smooth and timely access to treatment. Additionally, the navigator coordinates the regional Brain and Spinal tumor conference and co-facilitates the monthly brain tumor support group — one of the largest in the Legacy Health system.

Navigating brain and spinal tumors is physically, as well as emotionally, difficult for patients and their loved ones. In addition to physical challenges, these tumors can affect a person's cognitive function and may cause changes in personality, mood and other emotions (e.g. depression, anxiety, anger). The role of the navigator makes it possible for these patients and families to have an advocate — a nurse who is dedicated to making sure they receive the care, support and guidance they need and deserve.

Legacy Cancer Healing Center

By Niani Dunner, MPH, coordinator, Legacy Cancer Institute

The Legacy Cancer Healing Center is the umbrella under which support services reside for cancer patients and their families. A diagnosis of cancer



can affect many aspects of one's life; at the Legacy Cancer Healing Center, we bring a whole-person approach to improve quality of life, both during and after treatment.

Legacy Cancer Healing Center staff members work closely with the patient, their family and all members of the patient's cancer treatment team, offering assistance along the entire continuum of cancer care. Our aim is to assist patients with the physical, emotional and practical issues that arise from a cancer diagnosis and treatment. The Healing Center provides a comprehensive menu of group-based offerings, as well as individualized services provided by experienced, cancer-trained practitioners.

Individualized support services

- Integrative medicine offers individual consultation with a nurse practitioner.
- A licensed psychologist provides individual, couples and family therapy.
- Licensed clinical social workers address the emotional, social and financial concerns of the individual and family, as well as coordinate community services and resources.
- A Legacy dietitian, certified in oncology nutrition, offers individual consultations in nutritional counseling before, during and after cancer treatment.
- Art therapy uses various artistic mediums to allow patients to express themselves, and offers individual and group sessions for adults with cancer and their children.
- Massage therapy is offered free of charge at Legacy Good Samaritan Medical Center, both within radiation oncology and on the Cancer Care Unit. Fee-for-service and insurance-covered appointments are available in the Women's Wellness Center and are open to both men and women.
- Stress management provides support and comfort during difficult procedures, including external beam radiation and Gamma Knife radiation treatment for brain cancers.
- The Green Gables Guest House, on the campus of Legacy Good Samaritan Medical Center, provides lodging for cancer patients and families from out of the area receiving treatment at Legacy. Out-of-town patients and their families can utilize this convenient home away from home, located directly across the street from the home of Legacy Cancer Institute.

Cancer groups, classes and events

The Legacy Cancer Healing Center offers an array of groups, classes and events that support patients socially, emotionally and physically as they adapt to their cancer diagnosis, treatment and survivorship.

- An ongoing support group for brain tumor patients is held once a month at Legacy Good Samaritan Medical Center. It offers peer-to-peer support, as well as professional guest speakers on topics relevant to those with a primary brain-tumor diagnosis and their families.
- In 2018, we added a Women's Metastatic and Advanced Cancer Support Group at Legacy Salmon Creek Medical Center. For patients coping with advanced cancer (Stage IV or incurable) or cancer that has metastasized, this group provides tools from guest speakers, facilitators and other women.

- Art therapy groups, such as *Finding Center* and *Expressions of Healing*, are available at many of Legacy's medical center campuses. These classes provide cancer patients and survivors the opportunity to create and explore their cancer journey through art.
- *Step Into Fitness* is a series focusing on safe exercise and anti-cancer nutrition, post-treatment, co-taught by a physical therapist and oncology dietitian.
- *Eating to Heal: Adopting an Anti-Cancer Eating Style*, a new offering in 2018, introduces the cancer-fighting powers of a variety of foods, and allows participants to taste simple, delicious recipes using these superfoods.
- Also new in 2018, *I'm So Tired: Coping with Cancer Related Fatigue*, focuses on supporting and educating those dealing with fatigue associated with their cancer diagnosis.
- Offered for the 14th year in a row, *Meals That Heal* is a popular healthy eating and food preparation event for individuals post-cancer diagnosis.
Other ongoing offerings include monthly gardening workshops and nature walks, mindfulness meditation and weekly movement classes in Pilates, tai chi/qi gong and yoga. A comprehensive list of cancer support groups and classes offered is on page 32.

Oncology social work

By Sara Butler, MSW, LCSW, OSW-C, oncology social worker, Legacy Cancer Institute

Social workers strive to enhance human well-being, help meet basic human needs and “seek to enhance the capacity of people to address their own



needs” (National Association of Social Workers’ Code of Ethics). Oncology social workers help patients, their families and caregivers manage the emotional, financial and social impact of having cancer and living as a cancer survivor.

Legacy Cancer Institute has oncology social work support available onsite at Legacy Good Samaritan, Legacy Salmon Creek, Legacy Mount Hood and Legacy Meridian Park medical centers. For patients affected by brain and spinal tumors, referrals come from nurse navigators, providers and staff in radiation oncology, medical oncology, neurosurgery offices, as well as the Legacy Cancer Healing Center and outpatient rehabilitation. Social workers see patients and families in clinics and can provide support and information over the phone as well. All three of our LCI social workers have their clinical social work license, one is licensed in both Oregon and Washington, and one has oncology social work certification.

The NCCN defines distress in cancer as “a multifactorial unpleasant experience of a psychological (i.e. cognitive, behavioral, emotional), social, spiritual and/or physical nature that may interfere with the ability to cope effectively with cancer, its physical symptoms and its treatment.” Distress screening is done at certain points during and after cancer treatment by administering the NCCN Distress Thermometer and Problem List. In completing the distress screening, patients, families and caregivers identify areas of concern, including practical problems, family problems, emotional problems and spiritual/religious concerns. Oncology social work-

ers respond to distress and problems identified during distress screening by providing individualized assessments, support and resource information, and make referrals to providers and specialists as needed.

Many people affected by a brain or spinal tumor face multiple stressors such as financial strain from the loss of a job and increased medical bills, transportation challenges, or loss of the ability to independently care for themselves. A brain or spinal tumor diagnosis also impacts our patient’s family members, friends, support persons and caregivers. Oncology social workers work with patients, families and caregivers to provide emotional support and practical resources regarding adjustment to illness, disability, medical decision making, managing stress, home care, financial assistance (with both cost-of-living bills and medical bills) and transportation. Our LCI social work team manages four site-specific patient assistance funds, funded by Legacy Health foundations. These funds provide our patients with financial assistance for needs such as food and nutritional supplements, gas costs for daily radiation or assistance with over-the-counter medication and medication co-pays. Our social workers refer patients and their families to support groups (at Legacy and in the community) and services in the community and online resources from national organizations specific to people affected by brain and spinal tumors.

Oncology social workers address the psychosocial needs of our patients, families and caregivers. We work closely with providers, oncology nurse navigators, dietitians, the oncology psychologist and art therapist, and other support services. Our goal is to provide support throughout the continuum of care for our patients at Legacy Cancer Institute.

Oncology psychology services

By Valerie Correa, M.A., LMFT, Psy.D., clinical psychologist, Legacy Cancer Institute

Psychologists work with other medical providers for the optimum functioning for the patient and their families as they are enduring treatment. Patients



with brain and spinal tumors can find support to manage cancer treatments and the stress of the diagnosis, adjusting to potential limits in cognitive functioning and managing the fear of the progression of disease.

Brain and spinal tumors put an additional stress on a family system since the brain (the command center) is the focal point of the disease. This location often creates impairment in functioning where a caregiver may need help recognizing these limitations are emerging. Sometimes balance and coordination, sight, hearing, impulsivity and memory can be impaired depending on the area of the brain affected. Caregivers may have to assist in these challenges and help support the patient in ways they never had to before. Psychologists can assist in deciphering functioning and limitations with their oncologists and help create plans for adaptations with physical therapists.

Some patients may suffer from petit mal seizures and seem like they are “zoning or spacing out.” Or patients could suffer from a complete grand mal seizure, and caregivers worry about their loved one falling, hurting themselves while they are unconscious or seizing uncontrollably. This is often a shocking and terrifying event for the patient and their loved ones until seizure medications or surgery can improve the condition. Psychologists can help create a safety plan for prevention.

Besides the patients, caregivers gain information on fatigue for their loved ones, how organizational skills may be needed to adapt, how depression,

anxiety and trauma are a common response for the patient and their caregivers. Skills are taught to help cope with these emotions and processes.

For example, when the brain is over stimulated by light, reading, encoding too much information or integrating senses, the cancer patient may soon feel overwhelmed with fatigue. The brain puts on the breaks through fatigue to limit being over-taxed. This quick progression is frustrating for the patient and their caregivers because it often seems limiting and unpredictable.

Depression, anxiety and post-traumatic symptoms are common in cancer patients. Primitive animalistic survival skills get activated when anyone gets diagnosed with cancer. This constant alert system is anxiety-provoking and exhausting, which often lends itself to a depressed state. Oncology psychologists can help the patient and their caregivers learn this survival instinct, create awareness of how to allow moments of rest and recovery, and how to soothe the stress.

Relational difficulties are likely to emerge in a marriage, a parenting relationship and or a social setting. Brain trauma is a complicated process and encompasses so many aspects of a person’s life. Often relationships are accustomed to functioning in a certain way and when a brain cancer develops, often, new patterns of relating develop also. This can be alienating and lonely for the patient with a brain or spinal tumor and their loved ones. Psychologists can help navigate these new waters with the patient and their loved ones. There are multiple avenues that psychologists can provide help.

Integrative care for patients with cancer

By Reza Antoszewska, NP-C, survivorship and integrative care, Legacy Cancer Healing Center, Legacy Cancer Institute

Legacy Cancer Institute's integrative medicine clinic has been serving patients for over 10 years. Clinic services are available at Legacy Good Samaritan,



Legacy Meridian Park and Legacy Mount Hood medical centers.

The clinic provides lifestyle, functional and mind/body medicine to provide integrative, individualized care to our patients to help with symptom prevention and reduction during and after treatment.

Information and education regarding cancer risk-reduction through lifestyle modification is an important part of post-treatment care. Issues such as memory, sleep, pain, fatigue, poor appetite, stress and anxiety are managed in a holistic manner, with consideration for the many aspects of patients' lives that may impact their health and symptoms. Management is often accomplished in collaboration with other providers to provide truly integrative care.

Patients appreciate the ability to have their symptoms holistically addressed and to participate in improving their health and well-being.

Keeping current with strides in the fields of lifestyle, functional, mind/body and integrative medicine allows for continuous development of evidence-informed care for the benefit of our population.

Many patients participate in alternative therapies outside of the traditional health care system along with their cancer treatment. Some of these non-traditional treatments may be helpful; others may be harmful. The clinic provides a resource for patients and providers where alternative treatments, herbs and supplements are assessed for safety and efficacy.

The clinic works closely with our pharmacy in providing quality supplements to our patients through our Apothecary. With the generous

support of the Legacy Foundations, we have a grant to provide those supplements to patients who otherwise could not afford them.

Diet, exercise, restorative sleep, emotional resilience, social support and the patient's environment are all taken into consideration in developing a plan in shared agreement with the patient. Supplements, mindfulness training and modifications in lifestyle become part of the plan to improve the patient's well-being. Our clinic works with patients to assist and motivate them to take the steps needed to make healthy lifestyle changes.

Referrals to appropriate resources within and outside of the Legacy Health system are a regular part of the patient's individualized plan. Referrals such as physical therapy, pharmacy navigator, counseling and acupuncture are often part of the plan. Providers who are outside of the Legacy Health system are carefully vetted for competent and compassionate care.

Mind/body medicine and mindfulness are useful in our patients' coping and symptom management, as well as in helping our providers maintain resilience and compassion. Classes in mindfulness are available for patients and their loved ones at multiple Legacy locations. Mindfulness training is also available several times per year to all staff and providers throughout Legacy Health with the support of Employee Health, Nursing Services and the Legacy Provider Wellness Committee.

As part of their clinic visits, patients may also be assisted using one-on-one training in mindfulness and other mind/body skills such as heart-rate variability biofeedback. Referrals to our clinic are predominantly from physicians and allied health care providers. The patient may also self-refer. Visits are billable to most insurance, including Medicare and Medicaid. Our patients appreciate this service and express the value of learning ways to minimize symptoms during and after treatment, and to improve health and well-being after treatment has ended. For more information, call 503-413-6550.

Speech-language pathology support for patients with brain and spinal tumors

By Julia Robinson, M.S., CCC-SLP, speech-language pathologist, Legacy Rehabilitation Services

Speech-language pathologists (SLPs) play an important role on a multidisciplinary medical team for brain and spinal tumor patients. A wide variety of impairments can result from these cancers, either by direct effect at the tumor site, or the sequela of surgery, chemotherapy or radiation treatments. Patients may experience temporary or permanent changes. For example, patients can suffer



from dysphagia (swallowing difficulty) and associated complications, aphasia (language impairment, which can affect both expressive and receptive skills), apraxia (difficulty with motor-planning the sequence of movements for speech production), dysarthria (difficulty coordinating muscles of the mouth for speech production, which reduces speech intelligibility) and cognitive impairment.

Patients can also experience cancer treatment related cognitive impairment (CTRCI). These symptoms may include difficulty with memory, concentration, organization, problem solving, word finding, processing speed and cognitive endurance. These difficulties may affect a patient's effectiveness at work, home and in the community, and may cause stress for both patients and their families. SLPs can help address all of these conditions.

The speech-therapy process often involves testing before and after surgery, and/or during treatment, to measure function and recovery. The period before rehabilitation occurs between the time of the initial cancer diagnosis and the beginning of acute treatment. During this time, SLPs administer a variety of assessments that help establish patients' baseline functioning, which can then be used as a reference point for post-operative, cognitive-com-

munication functioning. During and after active cancer treatment, rehabilitation interventions can help prevent a decline in quality of life related to the cancer and the side effects from its treatment.

SLPs work with cancer patients through speech, language, swallowing and cognitive exercises. Therapy focuses on retraining the brain to use cognitive-communication strategies to re-establish skills and/or to compensate for the parts of the brain that have been damaged. A few examples of compensatory strategies include low- and high-tech communication devices (e.g., computer applications, alphabet boards), calendars and organizers to help with recall and time management, pacing strategies to reduce fatigue, and word-finding strategies to improve communication. If swallowing is affected, treatment can include diet modification and/or compensatory airway-protection strategies and swallowing exercises.

During speech-therapy treatment, exercises and strategies are adjusted as needed depending on patients' functional decline, side effects of cancer treatments, and any other issues patients may experience. SLPs emphasize patient-centered care that respectfully motivates patients and teaches them how to self-implement exercises and compensatory strategies post rehabilitation.

Finally, the multidisciplinary-team approach offers interventions and support to address patients' and their families' needs and goals. The team approach maximizes patients' functional recovery and helps them improve their quality of life, self-reliance and self-confidence. For more information, call 503-413-3707.

Palliative care for patients with brain and spinal tumors

By Emily Huber, M.D., Legacy Medical Group–Palliative Care

The National Comprehensive Cancer Network (NCCN) states that “the goal of palliative care is to anticipate, prevent and reduce suffering” of patients



living with cancer. Palliative care is a team-based model of medicine to address not only physical symptoms, but the psychological, social and spiritual challenges that come along with a cancer diagnosis. A palliative care team can include medi-

cal providers, social workers and chaplains, and embraces the fact that all are intertwined. Palliative care can begin at the time of cancer diagnosis and be provided alongside cancer-directed therapy.

Brain and spinal cancers present a unique set of challenges that impact patient and families' quality of life. Although treatments are advancing, many are still incurable. While cancer-directed treatment can often alleviate symptoms and prolong life, many patients are struggling with an illness that will likely end their lives. Despite a relatively high symptom burden, recent research shows that patients utilize palliative care less frequently and later in the disease progression when compared to other cancer populations.

Patients with brain and spinal cancers often have physical symptoms including fatigue, headache and nausea. Mood disorders such as anxiety and

depression are common. Patients may experience worry about becoming a “burden” as they develop problems with balance and coordination. Family members often express sadness that they have already “lost” their loved one as patients go through changes in their cognition, behavior and ability to communicate. In advanced disease, agitation and confusion can be distressing for patients and family members.

The palliative care team manages physical symptoms, with both pharmacologic and non-pharmacologic treatments. They provide anticipatory guidance as to what a patient might experience as they go through treatment or as their disease progresses. They explore what matters most to patients, and who can make medical decisions that honor those values if the patient cannot speak for themselves. They support patients and families' faith traditions or spirituality and help patients with legacy-making.

Legacy Palliative Care Services is committed to providing an additional layer of support for patients and their families. Palliative care is available both inpatient and outpatient at all of Legacy's medical centers except Legacy Silverton Medical Center at this time. For more information about palliative care services, call Legacy Medical Group–Palliative Care directly at 503-413-6862.

Community involvement 2018

Community events

March

Breast Cancer Issues (Komen)

June

“Pink at the Park” breast cancer awareness night
(Gresham Greywolves)

October

“Worship in Pink” (Komen)
Relay for Life (American Cancer Society)

Prevention and screening education and activities

March

Colorectal cancer awareness and screening promotion activities for employees/visitors at Legacy Good Samaritan, Legacy Mount Hood and Legacy Salmon Creek medical centers

June

“Spring into Good Health” breast cancer risk reduction and screening awareness event for community members in the Legacy Good Samaritan healing garden

October

Women’s cancers (breast and gynecology oncology) awareness activities and education for employees and visitors at Legacy Meridian Park, Legacy Good Samaritan, Legacy Mount Hood and Legacy Salmon Creek medical centers

Ongoing

Lung cancer screening program for high-risk individuals

Tobacco cessation counseling for those in lung screening program

“Meals that Heal” and “Cancer Superfoods” nutrition classes for patients and caregivers

Free screening mammograms for uninsured or underinsured low-income women, through the Oregon ScreenWise Program (previously BCCP), at Legacy Good Samaritan, Legacy Emanuel, Legacy Meridian Park and Legacy Mount Hood medical centers

Groups, classes and events for cancer patients offered in 2018

Support groups

Brain Tumor Support Group

Women’s Metastatic and Advanced Cancer Support Group

Breast Cancer Support Groups

Gynecological Cancer Support Group

Head and Neck Cancer Support Group

Prostate Cancer Support Group

Movement classes

Yoga for Individuals with Cancer

Pilates for Individuals with Cancer

T’ai Chi and Qi Gong for Individuals with Cancer

Bodies in Balance

Step into Fitness: A Healthy Lifestyle Program

Art therapy programs

Expressions of Healing: Art and Community

Finding Center: Art Making for Mindfulness and Stress Reduction

Felting Workshop: Fiber Arts for Adults with Cancer

Words for Healing: A Writing Workshop for Women
Healing from Cancer

Poetry for Healing

Artist in Residence Program

Mind-body classes and special events

Mindfulness Meditation

Gardening Workshop for Individuals with Cancer

I’m So Tired: Coping with Cancer Related Fatigue

Meals That Heal

Eating to Heal: Adopting an Anti-Cancer Eating Style

Outreach via social media

The Legacy Community Relations and Marketing Department is an important partner with the cancer program in reaching the community through social media messaging, website content and banners, and targeted direct mail. Facebook posts, often related to cancer awareness months, aim to engage and motivate readers toward healthy behaviors.

Professional education activities 2018

Conference and courses

April

The Seriousness of Sarcomas

September

Cervical Dysplasia Prevention and Management
Vulvar and Vaginal Dysplasia Classification and Management

October

14th Annual Pacific NW Excellence in Breast and Gynecologic Care Conference
Pink and Purple Endometrial Cancers

December

ABCs of Breast Cancer Diagnosis

Cancer patient care conferences (tumor boards)

Brain/CNS Tumors (Legacy Good Samaritan)
Breast Care (Legacy Good Samaritan, Legacy Meridian Park, Legacy Mount Hood, Legacy Salmon Creek)
Breast Cancer Radiology/Pathology Correlation (Legacy Good Samaritan, Legacy Meridian Park)
Gastrointestinal Tumors (Legacy Good Samaritan, Legacy Meridian Park)
General Cancer Conference (Legacy Meridian Park, Legacy Mount Hood, Legacy Salmon Creek)
Gynecologic Cancers (Legacy Good Samaritan)
Head and Neck Tumors (Legacy Good Samaritan)
Metastatic Breast Care (Legacy Good Samaritan)
Pediatric Oncology (Randall Children's Hospital)
Thoracic Tumors (Legacy Good Samaritan)
Urologic/Prostate Tumors (Legacy Good Samaritan)

Publications 2018

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Walcott-Sapp, S., Johnson, N., Garreau, J. Use of Integrative Services is Associated with Maintenance of Work Schedule During and After Cancer Treatment. *The American Journal of Surgery*, Jan 2018; 215(5): 898

Nguyen TT, VanderWalde, L., Bellavance, E., Eisenhauer, T., Hieken, T., Johnson, N. Ethical Considerations of Medical Photography in the Management of Breast Disease. *Annals of Surgical Oncology*, Oct 2018(10): 2801-2806.

Cook, M., Johnson, N. Pre-surgical Chemotherapy for Breast Cancer May Be Associated with Improved Outcomes. *The American Journal of Surgery*, March 2018; 215(5): 931-934.

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Carolson, K., Chung, A., Mirocha, J., Donovan, C., Estrada, S., Siegel, E., Giuliano, A., Amersi, F. Menopausal Status and Outcomes of BRCA Mutation Carriers with Breast Cancer. *The American Surgeon*, Oct 2018, 25(4): 1584-1588.

Legacy Cancer Institute Integrated Network Cancer Committee members 2018

Mindy Ansteth, B.S., CTR, manager, Cancer Data Management, and quality improvement consultant, Legacy Cancer Institute

Jonathan Avery, president, Legacy Good Samaritan Medical Center

Sallie Bowman, director, Legacy Spiritual Care—Legacy Good Samaritan Medical Center

Christine Brown, R.N., community outreach and activity coordinator, Legacy Cancer Institute

Sara Butler, MSW, LCSW, OSW-C, oncology social worker, Legacy Cancer Institute

Andrew Cox, M.D., interventional and diagnostic radiologist, Diagnostic Imaging NW, Legacy Good Samaritan Medical Center

Dawn Cox, CTR, supervisor, Cancer Data Management, Legacy Cancer Institute

Jennifer Garreau, M.D., breast surgical oncologist cancer conference coordinator, LMG Surgical Oncology

Susan Gray, M.S., R.N., manager, cancer programs, Legacy Cancer Institute

Pam Kilmurray, director, Legacy cancer service line, Legacy Good Samaritan Medical Center Rehabilitation Services, Legacy Breast Health Center and Legacy Hospice

Jutta Kress, BSN, RN, OCN, nurse education and practice specialist, Legacy Cancer Institute

Nathalie Johnson, M.D., FACS, breast surgical oncologist, medical director, Legacy Cancer Institute and Legacy Breast Health Centers

Katherine Leonard, Ph.D., psychologist, private practice

Heather Mikes, D.O., palliative care, Legacy Medical Group

Marci Reed, RD, CSO, L.D., dietitian, Legacy Cancer Healing Center

Kelly Rice, Pharm.D., oncology pharmacy navigator, Legacy Cancer Institute

Alizah Rotramel, M.D., FACS, colorectal surgeon, cancer liaison physician, LMG Colon and Rectal Surgery

Mark Schray, M.D., radiation oncologist, medical director, Legacy Medical Group—Radiation Oncology

Ann Smith-Sehdev, M.D., anatomic and clinical pathologist, medical director, Anatomic Pathology, Cascade Pathology, Legacy Health

Leslie Sorenson, CCRP, manager, oncology clinical research and genetics, Legacy Cancer Institute

Paul Tseng, M.D., MBA, gynecologic oncologist, chair, Integrated Network Cancer Committee, LMG Gynecologic Oncology

Therese Tuohy, Ph.D., CGC, genetics counselor, Legacy Healing Center

Gail Weisgerber, P.T., manager, acute care and outpatient rehabilitation, Legacy Good Samaritan Medical Center

Subcommittees of the Integrated Network Cancer Committee

Cancer Data Management Quality Committee

Cancer Quality Advisory Council

Cancer/Public Professional Education and Marketing Council

Cancer Program and Quality Committees

Brain and Spinal Tumor Program Committee

Breast Program Leadership Committees at Legacy Good Samaritan, Legacy Meridian Park, Legacy Mount Hood and Legacy Salmon Creek medical centers

Cancer Support Services Quality Committee

Center for Colorectal Cancer at Legacy Good Samaritan Medical Center

Colorectal Cancer System-wide Quality and Operations Meeting

Gynecologic Oncology Program Development

Oral, Head and Neck Program Planning

Hospice Quality (QAPI)

Lung Cancer Screening

Radiation Oncology Quality Committee

Thoracic Program Development

Honors and accreditations 2018



Legacy Health ranks among the nation's best cancer programs, according to the American College of Surgeons' (ACS) Commission on Cancer, a respected authority on cancer care. The Commission also awarded Legacy's cancer program its Outstanding Achievement Award in the last three accreditation surveys.



Legacy Cancer Institute was the first in the United States to receive Network Cancer Program accreditation from the ACS, and we are still Oregon's only accredited network cancer program. Patients can receive the same award-winning care at any of our campuses, closer to home.

The Legacy Breast Health Centers at Legacy Good Samaritan, Legacy Meridian Park, Legacy Mount Hood and Legacy Salmon Creek medical centers have earned the prestigious accreditation for excellence in the care of patients with breast cancer and benign breast disease from the American College of Surgeons' National Accreditation Program for Breast Centers (NAPBC).



In addition, the Legacy Breast Health Centers at Legacy Good Samaritan, Meridian Park, Mount Hood and Salmon Creek medical centers are designated Breast Imaging Centers of Excellence by the American College of Radiology. To achieve this distinction, a facility's imaging services must be fully ACR-accredited in mammography, stereotactic breast biopsy, breast ultrasound and ultrasound-guided breast biopsy.



Legacy Cancer Institute is one of only three nationally accredited blood and bone marrow transplant providers in Oregon. Learn more about FACT, the Foundation for the Accreditation of Cellular Therapy, which evaluates programs nationwide.



Legacy Medical Group—Radiation Oncology at Legacy Good Samaritan, Legacy Mount Hood and Legacy Salmon Creek medical centers is accredited by the American College of Radiology (ACR) Radiation Oncology Practice Accreditation (ROPA) program. Legacy Health's radiation oncology staff, equipment, treatment planning and treatment records, as well as patient-safety policies and quality control/quality assessment activities are assessed to maintain ROPA accreditation. ACR accreditation provides Legacy's radiation oncologists with valuable third-party, impartial peer review and evaluation of patient care.



The Legacy Lung Cancer Screening Program at Legacy Good Samaritan Medical Center is accredited by the American College of Radiology (ACR) as an ACR Designated Lung Cancer Screening Center. To achieve this designation, the Legacy Lung Cancer Screening Program must maintain active ACR CT Accreditation in the ACR Chest Module and meet very specific requirements related to the screening population, staff qualifications, the ACR Lung Reporting and Data System (Lung-RADS), patient smoking cessation, CT equipment, quality control and imaging protocol.



Legacy Laboratory Services and Legacy Tumor Bank have achieved College of American Pathologists (CAP) accreditation, which ensures high standards for quality and consistency in collecting, processing and storing tumor specimens.



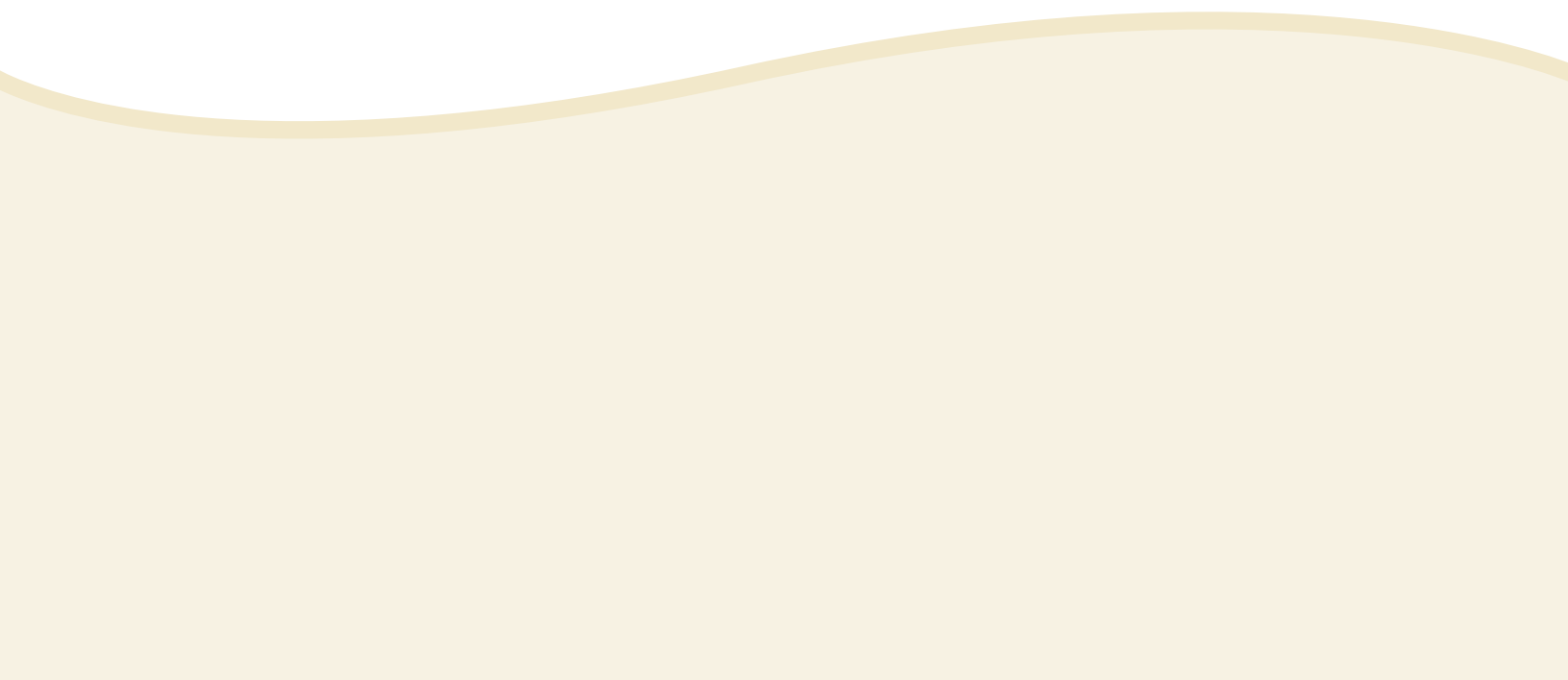
Legacy Oncology Clinical Research received approval for NRG Oncology research group main membership.



Legacy Oncology Clinical Research is recognized by National Cancer Institute leadership in 2018 as a high-performing site based on accrual.



Legacy Cancer Institute earned a 2018 Association of Community Cancer Centers (ACCC) Innovator Award for the "The Oncology Pharmacy Navigator: A New Best Practice Model for Managing Medication in Cancer Programs."



Legacy Cancer Institute

503-413-8050

www.legacyhealth.org/cancer



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