

Cancer Care Annual Report





Focus on the Children's Mercy
Brain Tumor Program

2012 Cancer Care Annual Report
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If words were colors, cancer would be black.

Fortunately, it doesn't have to be like that. At Children's Mercy, we're dedicated to bringing color into children's and families' lives.

Our cancer program is one of the best in the country in outcomes and, we believe, it is the best in terms of our dedicated and compassionate staff and our first-rate, child-friendly facilities.

It would be unrealistic to publish the stories of the nearly 2,000 children with cancer and blood diseases we serve each year; but a few are included in this report and their stories represent all of our children. The stories share some common themes:

One step at a time

Despite the odds

Fear

One of the family

And my personal favorite: *All grown up.*

We've also included highlights from some of the programs that distinguish us from other hospitals: the Cytogenetics Laboratory where we see how a person's genetic makeup can determine the best cancer treatment; our Hispanic Oncology Clinic, designed to best serve our growing patient base in their natural language; Radiation Oncology, a critical tool in helping shrink some tumors; and the Experimental Therapeutics in Cancer Program that in just its fourth year is at the forefront of making cancer medications safer and more effective for children.

At the center of all our work is a dedication to children and their families. We treat nearly 90 percent of all newly diagnosed pediatric cancers in our region, and our outcomes rank among the best in the nation. We can't do this all ourselves so we strive for excellence with our partners like the University of Missouri – Kansas City, the KU Cancer Center and more.

We do all of this to transform lives. Lives of children with cancer. Lives of parents and siblings who don't know what hit them. Our lives are changed, too.

And the sun comes up each day, colors emerge and brightness overcomes the dark at Children's Mercy.



Randall L. O'Donnell, PhD
President and CEO
Children's Mercy

A handwritten signature in white ink that reads "Randall O'Donnell". The signature is written in a cursive, flowing style.



Dear Colleagues,

It is my great pleasure to introduce this year's Children's Mercy Cancer Center Annual Report that focuses on one of our largest patient groups — children with brain tumors.

At Children's Mercy, between one-fifth and one-fourth of our patients in any given year come to us with a diagnosis of a brain tumor. As you'll read, the types of brain tumors afflicting children are quite varied and relatively rare and, as such, need well-trained and experienced providers.

Children with brain tumors require a vast array of specialty services and experienced clinicians to provide and oversee their care from the time of diagnosis to their long-term follow-up and transition to adult providers. We are fortunate to be able to provide to our region just such a team of highly trained, highly skilled and highly experienced providers of care for children with brain tumors. Led by Kevin Ginn, MD, a board-certified Pediatric Oncologist with advanced subspecialty training in Neuro-Oncology, our Brain Tumor Team consists

of board-certified pediatric specialists in Oncology, Neurology, Neurosurgery, Rehabilitation Medicine, Radiation Therapy, Developmental Medicine, Neuro-Pathology, Neuro-Radiology, Bone Marrow Transplantation and Neuro-Psychology. Adding to this team of providers are highly trained individuals from the pediatric disciplines of nursing, pharmacy, nutrition, social work, education, child life and chaplaincy who are solely dedicated to the care of these patients.

Under the direction of Dr. Ginn and the team of 23 Pediatric Hematology/Oncology specialists at Children's Mercy, our unique case management system teams an advanced nurse practitioner with each physician to individually oversee each child's therapeutic course and long-term followup. Utilizing a dedicated Hem/Onc clinic/outpatient infusion center and a 38-bed hepafiltered Hem/Onc floor, our patients have 24/7 inpatient and outpatient specialist coverage delivering the latest therapies, including access to clinical trials from the National Cancer Institute's (NCI's) Children's Oncology Group

and other pediatric research consortiums, including new experimental agents in conjunction with our Phase I Experimental Therapeutics Program at Children's Mercy.

Each child diagnosed with a brain tumor, and in the care of our team, undergoes thorough review, including discussion among all the team's specialists at twice-monthly Brain Tumor Patient Conferences. Engaging these specialists on the team and the full spectrum of Pediatric medical and surgical specialists at Children's Mercy ensures that every child receives the best therapy possible.

I invite you to read on and see for yourself the full array of services and the resulting improvement in outcomes for our patients.

Alan S. Ginn, MD, MPH
Associate Division Director, Division of Hematology/
Oncology/BMT
Chief, Section of Oncology



Dear Friends and Colleagues,

It is with great pleasure that we present the 2012 Cancer Care Annual Report from Children's Mercy Cancer Center with a focus on Central Nervous System Tumors. It is hard to believe that a year has passed since my return to Children's Mercy from Neuro-Oncology training at St. Jude. As you may know, I accepted a faculty position after training in Hematology/Oncology at Children's Mercy. My goal was to develop a formalized pediatric brain tumor program after my return from Memphis. I felt right at home here at Children's Mercy from day one and was excited to have this opportunity to develop an important program with the support of the hospital administration and faculty.

This is an exciting time in Pediatric Neuro-Oncology. Neurosurgical techniques and equipment have improved over the decades leading to more complete resections. Complete resection is important in almost all CNS tumors. Targeted agents are being expedited to clinical trials through high-throughput screening of agents already available on the market. Molecular profiling of large collections of tumors is leading to more information regarding not only cells of origin or new targets, but also better grouping of

patients based on genetic risk. Some of the work in medulloblastoma has shown us that the molecular profiling of these patients can better predict outcome than the traditional risk stratification methods still in use. Advances made in radiation delivery and planning have reduced the exposure of normal tissue to the detrimental effects of radiation. Proton beam radiation centers continue to be built across the country with the hope that this modality has the same outcome as traditional radiation while reducing toxicity to normal tissues. Long-term studies are still lacking to determine if this is, in fact, the case.

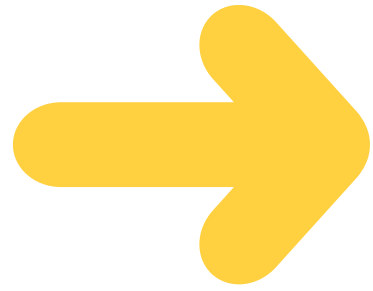
Through all of these advances, which are most importantly aimed to increase the survival of patients, care continues to be placed on the morbidity associated with therapy. What benefit have we provided a patient who survives if they are so devastated by the therapy involved that they are unable to function adequately in society?

This report focuses on all tumors seen at Children's Mercy during 2012 with a more broad focus on CNS tumors seen over a decade. Also, you will find descriptions of the multidisciplinary approach to

CNS tumors here at Children's Mercy and how each department plays an important role in the care of every patient. Finally, we focus on other exciting programs and advances in our Division to keep you up-to-date on what is happening here.

Looking back over the past year, I think my first year should be themed, "Building a Team." All of the components were already present here at Children's Mercy and patients have always received excellent care, but now there is a specific group of care providers who have dedicated themselves to play an active role in the care of patients with CNS tumors. We meet regularly to discuss care and ensure our patients are getting the best possible therapy. Now as we move forward, we will focus on strengthening ties to local and international groups to increase our research base and bring more and more cutting edge therapy to the children of the Kansas City region.

Kevin F. Ginn, MD
Pediatric Neuro-Oncology
Director, Pediatric Brain Tumor Program



Division of Hematology, Oncology and Bone Marrow Transplantation

Each year, the Division of Pediatric Hematology, Oncology and Bone Marrow Transplantation (BMT) provides comprehensive care to nearly 2,000 children with childhood cancers, sickle cell disease, hemophilia and other blood disorders. Our team of more than 20 pediatric hematology/oncology specialists offers a level of expertise unavailable anywhere else between St. Louis and Denver, caring for 90 percent of newly diagnosed cases in our region each year. Plus, our role in several national research consortia helps make sure patients have access to the most recent advances in treatment. Our innovative research and comprehensive approach to care has led to survival rates at or above national averages for nearly every category of disease.



We are a comprehensive pediatric cancer center offering 13 clinical and research-focused multispecialty programs.



Working with the Center for Pediatric Genomic Medicine at Children's Mercy, we are at the forefront of research to better understand the genetic causes of cancer and translate that research into treatment that can improve care.



We offer aggressive treatment options for adolescent and young adult patients, as well as follow-up care and support to address the long-term health and psychosocial needs of these patients.



In 2012, we once again received accreditation from the American College of Surgeons Commission on Cancer.



Our Experimental Therapeutics in Pediatric Cancer program, working with our internationally recognized Clinical Pharmacology program, is helping make cancer medications safer and more effective for children here and around the world.



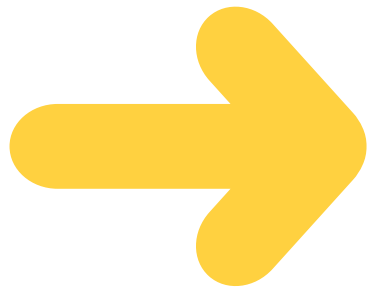
Patients have direct access to more than 80 clinical trials — including several national trials led by our own investigators, as well as trials through the National Cancer Institute's Children's Oncology Group and several other national research consortia.



Our pediatric bone marrow transplantation program is a regional center for Missouri, Kansas and Iowa, performing 35 transplants a year, including unrelated and related donor transplants for both malignant and non-malignant diseases.



We are the primary pediatric cancer provider and only NCI Children's Oncology Group institution in the Midwest Cancer Alliance, which links the NCI designated University of Kansas Cancer Center with member hospitals to advance cancer research and care.



Cancer Registry

The Cancer Registry at Children's Mercy operates under the direction of the Cancer Care Committee. All patients who are diagnosed or treated at Children's Mercy with a malignancy or a benign brain tumor are included in the cancer registry database. In the United States, hospital-based registries are the foundation of cancer surveillance. The primary goal of these registries is to improve patient care by evaluation of treatment outcomes. Data collected by the cancer registry may be used for physician education, research and facility utilization review. All data about the diagnosis, treatment, recurrence and survival must be collected in standardized detail. At Children's Mercy, the cancer program maintains accreditation from the American College of Surgeon's Commission on Cancer. As an accredited program the high quality standards of the Commission on Cancer, as well as other organizations they endorse, are followed in the data collection process.

During 2012, there were 183 new patients added to the cancer registry database. Of the 183 new registered patients, there were 44 who were diagnosed with central nervous system tumors, which is the focus of this annual report. CNS tumors were followed closely with 42 leukemia diagnoses. There were 17 patients who were considered benign reportable conditions. These patients were requested to be collected by the Cancer Care Committee for

surveillance purposes. Please see the frequency of diagnosis table for further disease breakdown.

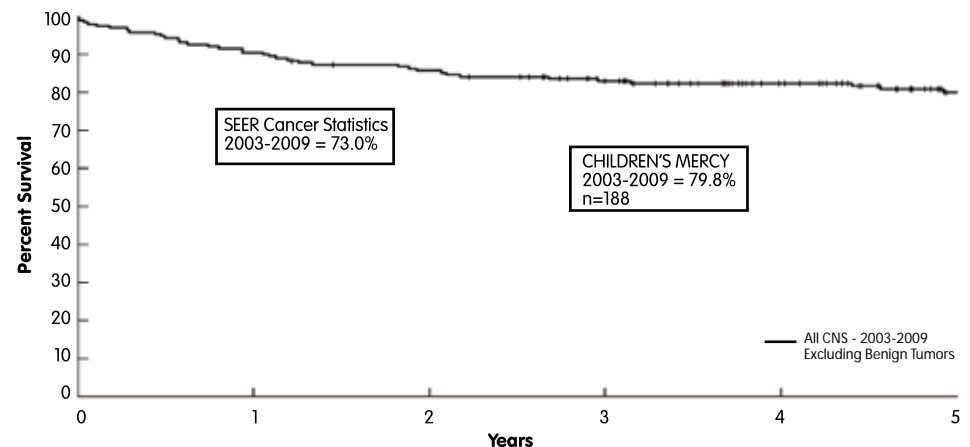
The median age of patients diagnosed during 2012 is 12 years. There were 25 patients less than 1 year of age diagnosed in 2012. The 1-4 year old age group consisted of 63 patients, the 5-9 year old age group had 42 patients, the 10-14 year old age group had 33 patients, and there were 20 patients in the 15-19 year old age group. There were 94 male patients and 89 female patients during 2012.

Race distribution included 156 Caucasians, 18 African Americans, and 9 designated as other race. Of the Caucasian patients, 25 were of Spanish/Hispanic ethnicity.

During 2012 the patients who were entered into the registry database came from five different states and 57 different counties. Fifty one percent of the patients were from Kansas, 47 percent from Missouri and 2 percent from other states.

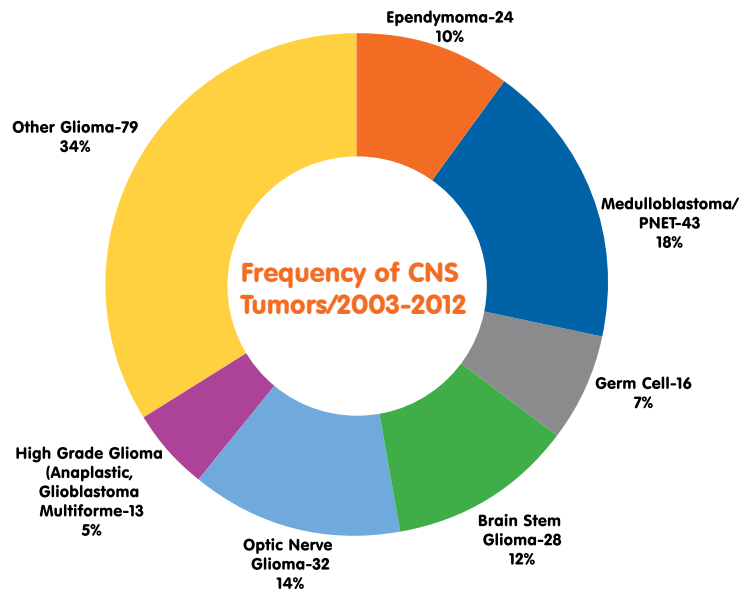
These patients will be followed in the coming years by the registry as were all of our previous patients. After treatment, if all Children's Mercy visits are curtailed, the registry will use other methods for follow-up. Strict patient confidentiality guidelines are followed according to HIPAA privacy regulations.

**CENTRAL NERVOUS SYSTEM TUMORS
5 YEAR RELATIVE OVERALL SURVIVAL
SEER VS CHILDREN'S MERCY
2003-2009- EXCLUDING BENIGN TUMORS**



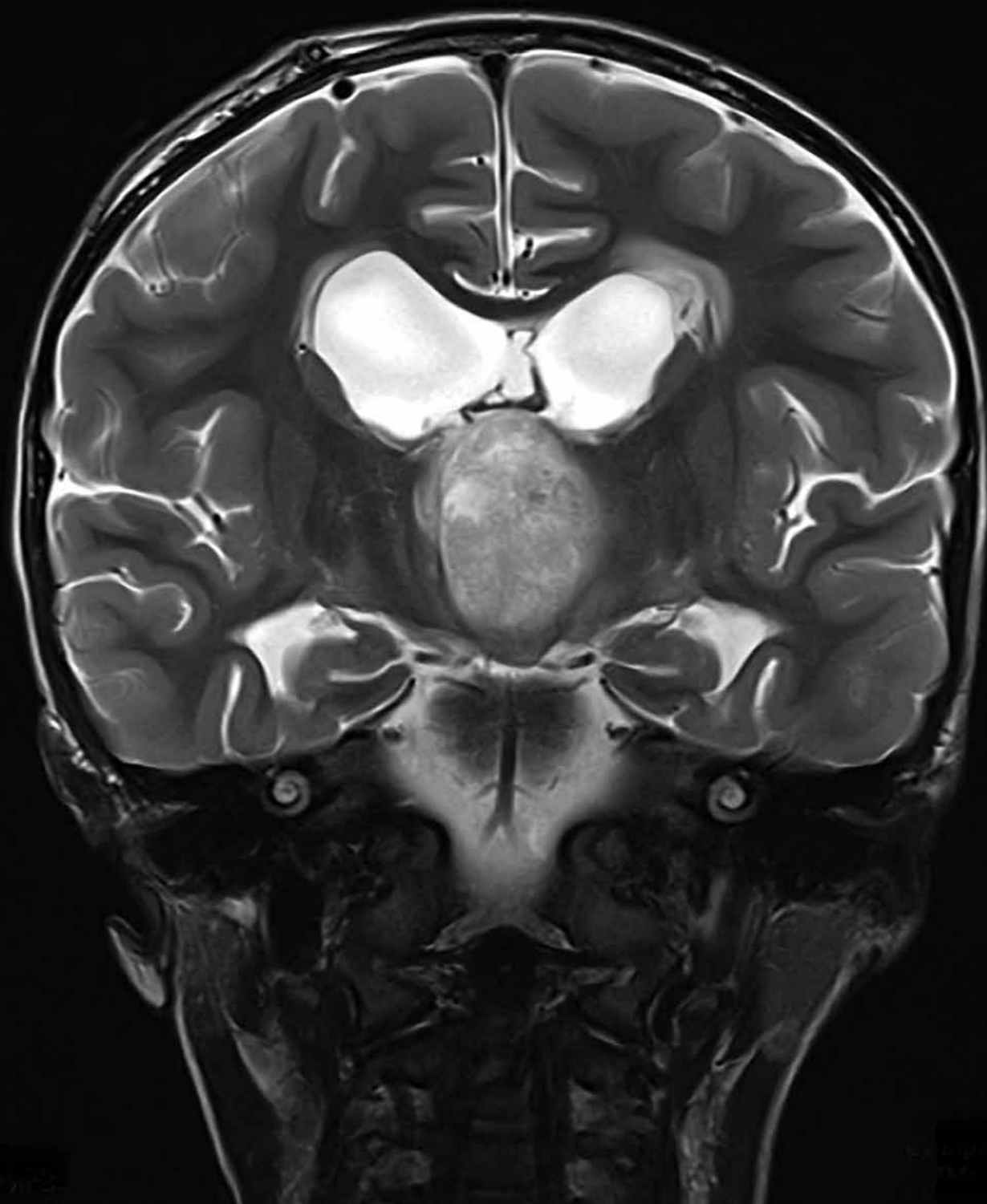
FREQUENCY OF DIAGNOSIS-2012

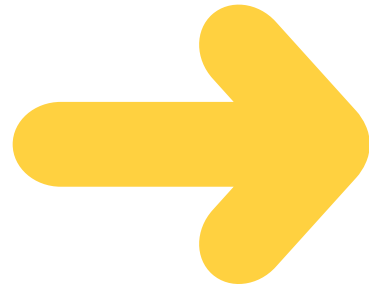
Diagnosis	Totals	Percentage
Central Nervous System	44	24
Astrocytoma	7	
Glioma	7	
Medulloblastoma	5	
Ependymoma	3	
Atypical Teratoid Rhabdoid	2	
Glioblastoma Multiforme	2	
Meningioma, Papillary	1	
PNET	1	
Choroid Plexus Carcinoma	1	
Benign Borderline CNS	15	
Leukemia	42	23
ALL	32	
AML	7	
JMML	2	
CML	1	
Lymphoma	12	7
Non-Hodgkins	6	
Hodgkins	6	
Neuroblastoma	19	10
Ganglioneuroblastoma	4	
Neuroblastoma	15	
Wilms Tumor	8	4
Hepatoblastoma	6	3
Rhabdomyosarcoma	5	3
Retinoblastoma	4	2
Ewings	4	2
Osteosarcoma	3	2
Germ Cell Tumor	3	2
Langerhan's Cell Histiocytosis	5	3
Melanoma	3	2
Sarcoma	4	2
Clear Cell Sarcoma of Kidney	1	
Epithelioid Sarcoma	1	
Undifferentiated embryonal	1	
Undifferentiated	1	
Other Malignant	4	2
Peripheral Nerve Sheath Tumor	1	
Medullary Carcinoma of Thyroid	1	
Myelodysplastic Syndrome	2	
Benign Reportable Conditions	17	9
Teratoma	9	
TMD/TAM- Transient Myeloproliferative Disorder / Transient Abnormal		
Myelopoiesis	2	
Plexiform Neurofibroma	2	
Hemangiopericytoma	1	
Ganglioneuroma	2	
Hemophagocytic Lymphohistiocytosis	1	
TOTAL	183	100



5 YEAR RELATIVE SURVIVAL RATES FOR CNS TUMORS NATIONAL / CHILDREN'S MERCY COMPARISONS 1995-2009 / Age 0-19

HISTOLOGY	ICD-0 Code	CBTRUS (1995-2009) Central Brain Tumor Registry of the United States	CM (1995-2009) Children's Mercy
Astrocytoma- NOS, diffuse, fibrillary	9400/3, 9410/3, 9411/3, 9420/3	83.2	88.3 (n=43)
Pilocytic Astrocytoma	9421/3	96.8	96.6 (n=90)
Anaplastic Astrocytoma	9401/3	31.2	25.0 (n=4)
Ependymoma - NOS, Anaplastic & Papillary	9391/3, 9392/3, 9393/3	73.8	61.6 (n=28)
Glioblastoma-Multiforme, Giant Cell	9440/3, 9441/3	18.2	16.6 (n=6)
Glioma malignant, NOS & Mixed	9380/3, 9382/3	59.0	71.4 (n=63) 51.2 (n=37 Excluding optic nerve site)
Embryonal Tumors-Medulloblastoma (all variants), PNET (Primitive neuroectodermal tumor), ATRT (Atypical teratoid/rhabdoid tumor)	9470/3 9471/3 9473/3 9474/3 9508/3	61.9	56.8 (n=77)
Germ Cell of CNS-Germinoma & Mixed Germ Cell	9064/3 9085/3 (2003-2009 data)	90.1	92.3 (n=13)





Brain Tumors

Central Nervous System tumors are the second most common type of tumor seen in pediatric patients after leukemia. We have seen significant improvements in survival rates for patients with leukemia over the last few decades, and although neuro-oncology has also seen some improvement, we have not made as many advances. We are currently on the cusp of a new era in biological understanding that will lead to better risk stratification, more targeted therapy and an improvement in survival rates, while decreasing the associated morbidity of patients with CNS tumors.

The National Cancer Institute collects cancer data representing 28 percent of the U.S. population to report incidence, prevalence and survival of cancer in the Surveillance Epidemiology and End Results (SEER) reports. From 1975 through 1977 they reported a 58.9 percent five-year relative survival of CNS tumors in patients aged 0-19 years. From 2003 to 2009 this same population had a five-year relative survival of 75.1 percent showing a statistically significant improvement in survival in three decades.

Established in 2002 the Central Brain Tumor Registry of the United States collects data on benign and malignant CNS tumor from state registries and estimates the incidence of a CNS tumor in the U.S. for patients 0-19 years of age is 5.13 per 100,000 with 3.3 per 100,000 being malignant cases. They estimate that 4,300 new pediatric CNS tumors will be diagnosed in the United States in 2013.

At Children's Mercy we see approximately 40 new patients each year with CNS tumors and closely monitor our survival data compared to national statistics to ensure we are providing state of the art care.

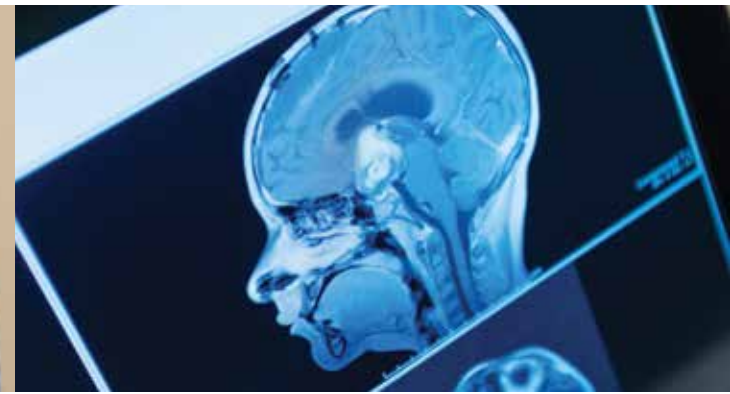
We will now provide general information and updates on the three most common types of CNS tumors seen in pediatrics, which together account for up to 80 percent of the CNS tumors we treat.

Low Grade Gliomas

Low grade gliomas are the most common type of CNS tumor encountered in a pediatric patient with approximately 50 percent of patients falling into this category. Low grade gliomas are a group of tumors that are classified as World Health Organization Grade I or II depending on pathological features and can occur anywhere throughout the central nervous system. They commonly appear in the spinal cord,

optic nerve or optic pathway, and in the posterior fossa/cerebellar region. Dissemination is rare and is estimated to be present in only 2 to 3 percent of patients at diagnosis. Complete surgical resection remains the therapy of choice for these tumors and if achieved is considered curative. Patients who are fortunate enough to have a gross total resection only require close follow-up imaging to ensure there is no recurrence. Recurrence happens in about 10 to 20 percent of cases after complete resection, and if identified, second surgical resection should be the first consideration, likely followed by additional therapy. As these are slow growing tumors that often are surgically resected, the survival is very good at greater than 90 percent five-year overall survival.

In patients where gross total resection is not possible, the therapy choices are limited to radiation or chemotherapy and the physician must consider each carefully depending on multiple factors.



Chemotherapy has become standard first-line therapy in those patients where it is desirable to avoid radiation either due to patient age, or due to the location of the tumor making long-term radiation effects concerning. Carboplatin and Vincristine are now considered standard first-line chemotherapy and is continued for approximately one year or until progression. The five-year progress free survival with this regimen as investigated on the COG A9952 clinical trial was 35 percent. After progression, there are several other chemotherapy regimens available and most result in only stability of disease rather than reduction in tumor volume, if effective at all. Although radiation is often more effective, the neuro-cognitive and neuro-endocrine long-term effects are undesirable. It has been reported that the five-year progress free survival with chemotherapy alone is 38 percent and with radiation plus chemotherapy is 68 percent. In those patients who are older with a low grade glioma, especially those tumors in a lower risk location, or tumors in patients with progression after multiple chemotherapy approaches, radiation is recommended.

For patients with Neurofibromatosis (NF1), who have a predisposition to low grade gliomas due to mutations in neurofibromin, radiation is avoided if at all possible no matter the age of the patient due to their higher risk of secondary malignancy and vascular effects post radiation. About 15 percent of patients with Neurofibromatosis will have an optic pathway glioma with a pilocytic astrocytoma histology. Low grade gliomas in Neurofibromatosis patients, for poorly understood reasons, are often slower growing or remain stable and have been reported to spontaneously regress. More understanding of these observed differences could shed light on biological activity of low grade gliomas in general.

Most of the current research in low grade gliomas has been related to understanding and targeting receptor tyrosine kinase pathways thought to play a critical role in development of these tumors. In 2008 a duplication of a section of chromosome 7 was identified in a majority of pilocytic astrocytomas. Later this duplication was found to result in fusion between KIAA1549 and BRAF leading to constitutive activation and is reported in 50 to 100 percent of tumors. Upstream of BRAF, RAS activation can also lead to increased signaling through the PI3K/AKT/mTOR

pathway. Loss of neurofibromin in Neurofibromatosis leads to less inhibition of Ras, and thus, increased signaling. Targeting any portion of this pathway is desirable for low grade gliomas, as well as other types of cancer, and research is ongoing with pre-clinical as well as clinical trials underway.

Medulloblastoma

Medulloblastoma is the second most common CNS tumor in pediatric patients but is often quoted as the “most common malignant brain tumor of pediatrics” as low grade gliomas are often referred to as “benign.” Medulloblastoma accounts for 20 percent of CNS tumors and the peak age is 4 years. These tumors by definition are posterior fossa/cerebellar tumors previously referred to as infratentorial primitive neuroectodermal tumors. Approximately 25 percent of patients have metastatic disease within the central nervous system at diagnosis and less than 5 percent have spread outside of the central nervous system.

Historically we know that older patients who have a complete resection who do not have metastatic disease and who are treated with craniospinal radiation and chemotherapy have the best survival rate. Five-year overall survival in these patients is



reported at around 85 percent. Those patients who have metastatic disease fair much worse with five-year survival reported in the 30 to 40 percent range. In patients with recurrent disease multiple options are available, but very few patients survive. We need

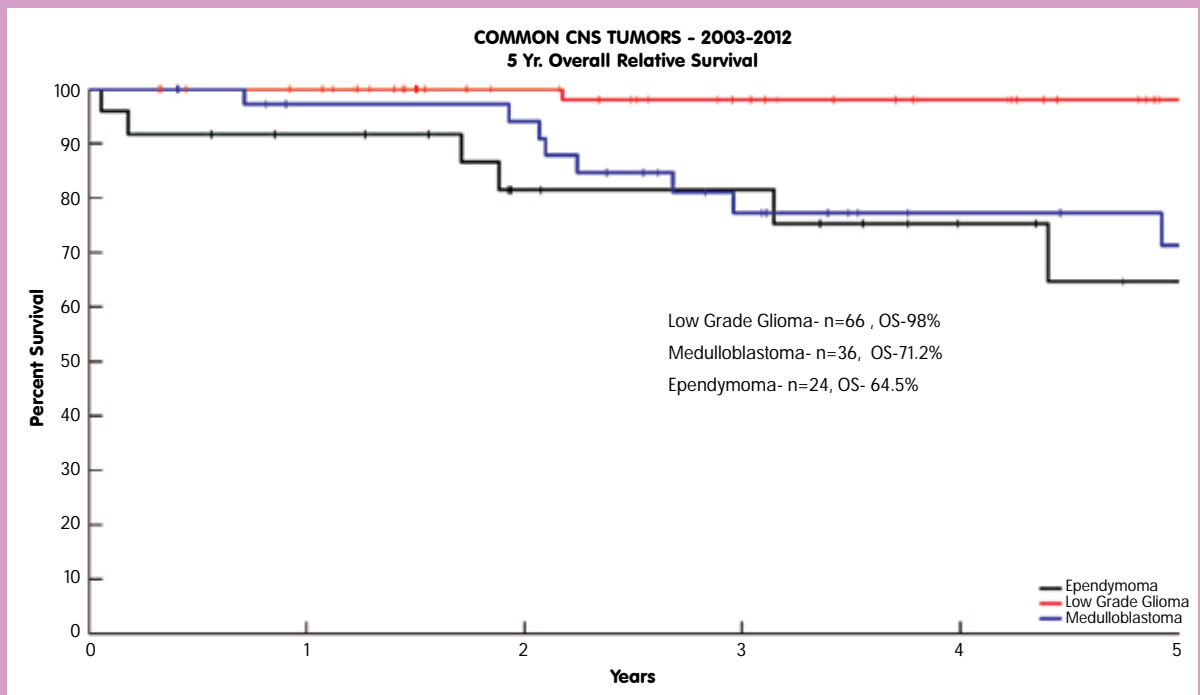
more therapy options for those patients with high-risk disease at diagnosis as well as those unfortunate enough to have a recurrence after initial aggressive therapy.

Current therapy protocols risk stratify patients

based on age, metastatic disease, residual tumor and diffuse anaplastic histology. Efforts in infants to avoid radiation have resulted in very intensive chemotherapy administration and most are treated with three courses of high dose chemotherapy with autologous stem cell rescue after three courses of induction chemotherapy. Patients older than 3 years of age proceed to standard therapy with immediate craniospinal radiation with posterior fossa boost and often a year of chemotherapy afterward. These patients may be cured of their disease but are often left with many issues, including neuro-cognitive deficits, neuro-endocrine deficits and hearing loss.

There have been significant improvements in our understanding of medulloblastoma since 2006 when early molecular subgrouping started being reported. The most recent published consensus regarding this work has recommended four molecular subgroups of medulloblastoma: WNT, SHH, Group 3 and Group 4.

- The WNT subgroup includes most often young patients who are rarely metastatic at diagnosis with very good prognosis with current therapy. Most discussions in the field regarding the WNT subgroup are related to how we might reduce





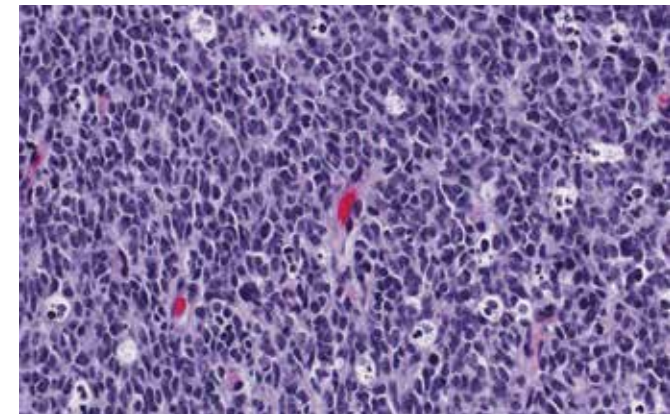
therapy, maintaining the excellent outcomes, and thus reduce subsequent morbidity. A reduction in radiation dose or even eliminating radiation altogether is the most appealing area for reducing therapeutic intensity.

- The SHH subgroup is most commonly seen in the very young and adult patients. They are uncommonly metastatic and have a good prognosis in infants and intermediate prognosis in other patients. They are defined by mutations in the SHH pathway with frequent changes seen in PTCH1/SMO/SUFU, GLI2 or MYCN. There are targeted inhibitors of this pathway available on the market such as the Smoothed inhibitor Vismodegib (GDC-0449) but most studies have shown a dramatic but temporary response to this agent alone. Work is on-going with agents to target this pathway and learn what may lead to escape from inhibition.
- Group 3 consists of tumors found most commonly in children and are more commonly metastatic at diagnosis with the worse prognosis of any of the other groups. They very frequently have MYC amplification, which is a poor

prognostic genetic finding. This group, as well as Group 4, have no common pathway that can be targeted like the SHH and WNT groups and will be more difficult to determine the next best approach to improving outcomes.

- Group 4 consists of an intermediate risk group that frequently has metastatic disease, but not as frequently as seen in Group 3. Again, this is a group that is difficult to easily define and will require much more investigation to better define individual targets.

The field of Pediatric Neuro-Oncology has been inspired by this work classifying medulloblastoma. It has been shown that molecular subgrouping better defines prognosis than the traditional risk stratification currently in use. Upcoming clinical trials will focus on grouping these patients based on this data and intensifying or reducing therapy based on their predicted outcomes. Targeted therapy is the wave of the future in oncology, although much work still needs to be done and it is unlikely that a single target without additional intensive and traditional therapy approaches will be successful in this disease.



Medulloblastoma is the second most common CNS tumor in pediatric patients.



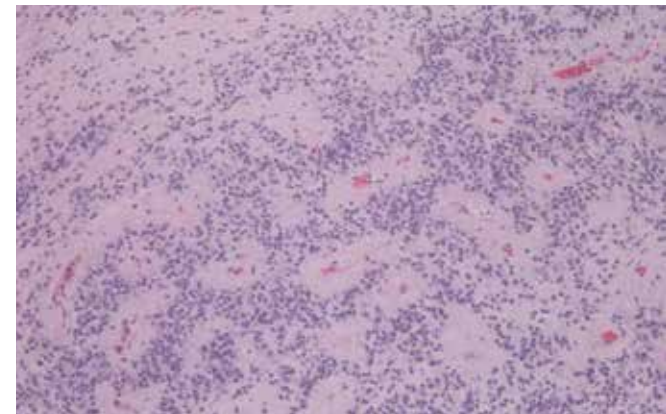
Ependymoma

Ependymomas are the third most common malignant central nervous system tumor in pediatrics accounting for approximately 10 percent of tumors. They arise from the ependymal cell layer of the ventricles or central canal of the spinal cord. Intracranial ependymomas are more common in those patients less than 4 years of age while spinal cord tumors are more common in those patients older than 10 years. Ependymomas are divided by the World Health Organization into three grades with Grade III, or anaplastic ependymoma, having the worst outcomes. Therapy is determined by the grade, location, age and extent of resection. Surgical resection has been shown to affect prognosis most significantly and if possible should be aggressively pursued in these patients. This has to, of course, be balanced with a desire not to harm the patient and leave them with devastating neurological deficits after surgery.

The only known genetic syndrome associated with increased risk of ependymoma is Neurofibromatosis type 2 (NF2), and those patients most often present with spinal cord tumors. Work is ongoing to

investigate genomic profiles and targets that may lead to improved stratification for therapy and new therapeutic agents.

In current clinical trials for ependymoma researchers are investigating effectiveness of chemotherapy as well as safety of avoiding any therapy in low-grade tumors with complete surgical resection. Many centers are already carefully watching patients with Grade I and Grade II tumors without any further therapy. Many others still consider radiation after surgery to be the standard, and current studies may answer this question and allow more children to avoid radiation. Patients with Grade III tumors are most often treated with a combination of chemotherapy and radiation, but even some of these patients have been observed if complete resection was achieved. For the youngest patients, avoiding radiation is always the goal, and intensive chemotherapy regimens are administered for this reason. Ependymoma is sensitive to chemotherapy, but less than half of infants treated with chemotherapy alone ultimately avoid radiation as they experience progression or relapse of disease.



Ependymomas are the third most common malignant central nervous system tumor in pediatrics accounting for approximately 10 percent of tumors.

Katelin's Courage: Recovering from Cancer, One Step at a Time

When 11-year-old Katelin Pittillo, of Garden City, Kan., began experiencing neck pain and weakness in her left arm, her mother, Mandi Pittillo, thought it was the result of a motorcycle accident she had been in a year earlier.

But when her symptoms continued to worsen, Katelin was referred to Christian Kaufman, MD, a pediatric neurosurgeon with Children's Mercy. That's when Katelin and her mom received the diagnosis that would change her life: she had an extremely rare type of cancer called spinal endyoma.

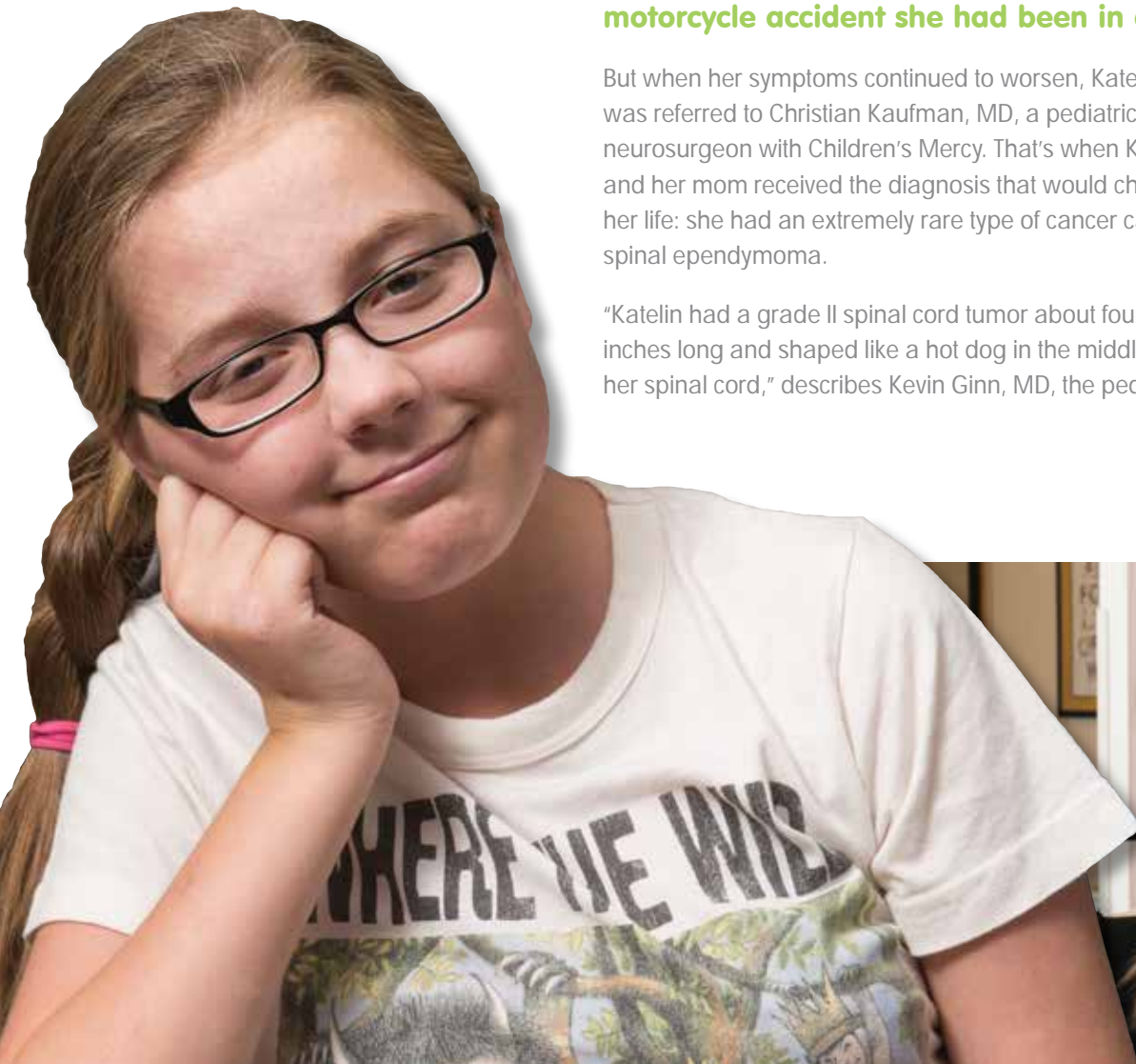
"Katelin had a grade II spinal cord tumor about four inches long and shaped like a hot dog in the middle of her spinal cord," describes Kevin Ginn, MD, the pediatric

neuro-oncologist who oversaw her care. "It started at the base of her brain and extended down her neck."

First Things First

For Katelin and her medical team, the first priority was to get rid of the tumor — immediately. "This surgery is a very delicate balance between trying to remove all of the tumor while protecting her function," Dr. Ginn says.

During an 11-and-one-half hour operation, Dr. Kaufman removed 90 percent of the growth. But it was wrapped around the sensitive nerves that control Katelin's motor





➔ Rehabilitation Medicine

Rehabilitation is often needed for patients with brain and spinal cord tumors, either due to the direct effects of the tumor on the function of normal tissue, or due to the morbidity associated with surgical removal of the tumor and other complications that may arise. **Dr. Kimberly Hartman** is an active member of the Neuro-Oncology Team and works with a team of specialists to improve function of those patients with neurological deficits. The Rehabilitation Team provides a collaborative model of care for children who have a change in their ability to perform everyday activities as a result of a brain or spinal cord tumor.

Whether a child has difficulty with mobility, self-care, cognition or overall strength and endurance, we develop a therapeutic plan to emphasize independence and return of function. This plan may involve different therapeutic disciplines (physical therapy, occupational therapy and speech-language pathology), equipment, assistive technologies, modalities and medications to help a child return to their favorite activities. As a child's needs change, our team is able to adapt and provide the appropriate support to maintain the highest quality of life for our patients and families.

For children undergoing surgery or treatment in the hospital, we offer an acute, intensive inpatient rehabilitation program to maximize functional recovery. Depending on the needs of the child and family, we also work closely with therapists in the community, as well as in the home, to provide the most appropriate level of individualized care.

The rehabilitation medicine team consists of the only board-certified pediatric physiatrists in the region, nurse practitioners, nurses, nurse coordinators, pediatric-trained physical and occupational therapists, speech-language pathologists, music therapists, and child life specialists. Our mission is to partner with families and other specialists to empower children with different abilities to lead extraordinary lives.

functions, and in spite of careful monitoring, she lost most of the function in her left arm and leg.

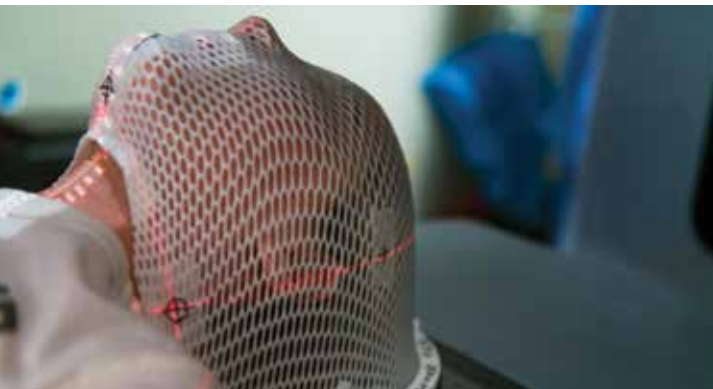
Taking the Next Step

Katelin's complicated case benefited from the team approach Children's Mercy offers. In addition to Drs. Kaufman and Ginn, Kimberly Hartman, MD, a specialist in physical medicine and rehabilitation, prescribed physical therapy to help Katelin regain the use of her left arm and leg.

"Following surgery, Katelin couldn't even take one step," Dr. Ginn says. That made the need for rehabilitation even more critical. Once she recovered from surgery, she was transferred to the hospital's inpatient rehabilitation unit where she quickly began the hard work necessary to walk again.

After spending 48 days in Children's Mercy, she was ready for the next step on her journey — continued rehabilitation as an outpatient at the Rehabilitation Institute of Kansas City; and radiation therapy at the

Above and left: Dr. Kimberly Hartman



Kansas City Cancer Center to treat the remaining tumor in her spine.

There's No Place Like Home

Almost three months after making the 377-mile trip to Children's Mercy, Katelin returned home. She had completed 27 radiation therapy treatments and intensive rehabilitation. Today she continues her physical therapy in Garden City and attends classes online until she is strong enough to return to the sixth grade.

"She took 40 steps with a walker on Oct. 3," Mandi says. "The connections are there. She just needs to re-train and re-strengthen her left side. She's made remarkable progress."

Though the road to recovery is a long one, Mandi is grateful for her daughter's positive attitude and her outstanding health care team at Children's Mercy.

"This was a very scary situation, but through it all, Katelin has kept her chin up and kept fighting," Mandi says. "Everyone at Children's Mercy took a genuine interest in her case. We were so far from home for so long, we couldn't have made it back here without them."

➔ Radiation Therapy

Many patients with brain tumors need radiation therapy and here at Children's Mercy we collaborate with **Vickie Massey, MD**, from the University of Kansas Cancer Center. She is board certified in Radiation Oncology and is a member of the Children's Oncology Group with many years of experience treating pediatric patients.

Radiation therapy has been a standard treatment modality for brain tumors for many years. Radiation therapy gives patients the option to have their tumors treated when invasive surgery isn't possible or is not enough to control the tumor. Many significant advances in imaging, radiation therapy and radiosurgery techniques have occurred recently, leading to improved delivery precision. This results in fewer acute and late effects. Treatment may include the whole brain, or most often, only a limited area. In all cases, the role of treatment is determined by the age of the patient, the diagnosis and areas of involvement, or the behavior of the tumor type.

Treatment is tailored for each patient to allow optimal control of the tumor, while preserving the most normal tissue. Our team approach to management is vital, as combined modality treatment is frequently employed, and the timing and dosing of therapy is critical. Patients come Monday through Friday, with therapy going on for several weeks. Some patients may be candidates for radiosurgery, which delivers higher doses of radiation in one to five treatment sessions. Because some of our children are so young, and unable to cooperate, we depend on the Children's Mercy anesthesiology team to deliver the most accurate therapy. Children's Mercy has partnered with the University of Kansas Cancer Center and the Midwest Gamma Knife Center at Research Medical Center to offer treatment options locally. Arrangements can be made to utilize national resources as needed.



Vickie Massey, MD → Radiation Oncology

Vickie Massey, MD, is one of just a few pediatric radiation oncologists in the country, and the only active one in the Children's Oncology Group in the Kansas City region. Her role is critical in treating the cancer tumor patients she regularly sees.

"Brain tumors are one of the most common tumors we see at Children's Mercy," she said.

Of the 183 newly diagnosed patients Children's Mercy treated in 2012, 44 of those patients were diagnosed with brain tumors. The number of cases is consistent with national figures, as brain tumors are noted as the most common solid tumors for children, according to the National Cancer Institute.

One therapy for brain tumors is radiation, which is used to attempt to shrink the malignant growths. The department treats an average of about 50 patients annually and nearly a dozen have brain tumors. The length of treatment for patients is about four to seven weeks and the success rate is dependent on the type of cancer, with the most favorable at 80 percent or more, Dr. Massey said.

A critical component to performing her job as a radiation oncologist comes from assistance through the anesthesia team at Children's Mercy, Dr. Massey said. The staff has a special touch in comforting the patient to create a calm environment.

"It's a complete approach," she said. "All the support teams are what makes Children's Mercy such a remarkable hospital. Everyone collaborates so well."

Children's Mercy oncologists will make the diagnosis. A team of oncologists, nurse case managers, therapists and social workers meet with the patients and parents for a planning session as to how to proceed with treatment. Dr. Massey meets with other oncology members and participates in patient conferences

"We have a pretty involved staff," Dr. Massey said.

Because of her unique position of having a specialty without nearby peers she finds assistance from a national network of pediatric oncologists who offer advice and tips about cases from their own experiences. They share data and clinical questions.

"I'm able to discuss cases with the national radiation oncology members and have multiple places where I can turn," Dr. Massey said. "They are so generous with their time."

Massey decided on the field of radiation oncology because of her own personal experience when her father had brain cancer. She was a medical student at the time and her father was only in his 40s. Her medical school mentor suggested a rotation with a radiation oncologist. The experience solidified her decision to make it her specialty. She finished her training at Memorial Sloan-Kettering Cancer Center.

"It's a very obscure field and that's how I learned about it," she said of her father's illness.

"In a treatment area where the latest equipment and techniques set the pace for therapy improvements, it's important to keep connections at a human level," Dr. Massey said. "We have a lot of machines, and technology is going to continue to improve our delivery, but in the end there is a patient."



Hailey's Come-back

Nothing seemed to soothe 17-month-old **Hailey Phegley** of Independence, Mo. during September of 2012.

She hardly moved or played, slept a lot and was often upset.

Her mother, Tricia Phegley, took her to the doctor who prescribed medication for a double ear infection.

Phegley waited for the antibiotics to take effect, but several days later Hailey still showed no improvement. In fact, her condition worsened.

"She started throwing up instead of getting better," Tricia Phegley said.

They returned to the doctor and left with a stronger prescription.

But there was still no change. Hailey's appetite disappeared. She started losing her balance and running into doors. She couldn't sit upright on a couch without falling over. The vomiting became more frequent and her hazel-colored eyes started crossing.

"She only wanted to sleep or be held," Tricia Phegley said.

Although Hailey was nearly 18 months old, she had not started walking.

"There were no other symptoms and we just agreed she was a late walker," Tricia said. "But now looking back, there was a brain tumor growing."



Ophthalmology

The pediatric ophthalmologists at Children's Mercy are active members of the team caring for patients with brain tumors. There are six full-time pediatric ophthalmologists at Children's Mercy who provide specialized examinations to look for early signs and subtle changes in the eyes of children affected by brain tumors.

The eye is one of the few organs in the body where you can simply look inside and gather valuable information. This non-invasive examination can provide details about a child's overall condition that greatly assist in decision-making about their cancer care. For example, a look at the back of the eye can track increases or decreases in intracranial pressure by mapping changes in swelling around the optic nerve. Checking visual acuity can look for radiation damage and give a "status report" for the eye.

Abnormalities in the nerves and muscles that coordinate eye movement can also be caused by brain tumors. Changes in the alignment of the eyes such as new crossing or the inability to move an eye in a certain direction can be very helpful in localizing tumors.

Occasionally, a brain tumor will be first suspected and subsequently diagnosed after a routine eye exam. Unexplained vision loss, new misalignment of the eyes or headache will often bring a patient to the eye doctor. Patients are then referred for neuroimaging if there are concerning findings during the eye exam.

Following a diagnosis of a brain tumor, and during the treatment phase, the ophthalmologist will then follow the resolution of these symptoms and remain in close communication with the oncology team.

Another important function of the ophthalmologist within the brain tumor team is to monitor slow growing intracranial tumors such as gliomas and meningiomas. Frequent eye exams in these patients, especially at very young ages can help to signal when aggressive versus conservative treatments can be employed. A subtle change of vision in a 2-year-old with neurofibromatosis can prompt the oncology team to search for an optic nerve glioma. By closely monitoring these patients with eye exams in clinic, the need for multiple sedations for neuroimaging can be reduced.

Finding the Problem

In late September of 2012 Tricia took Hailey to the eye doctor to see what might be causing the eye crossing. An exam with eye dilation revealed optic nerve swelling on both eyes.

"They said that means there's pressure in the brain and they sent us to the ER immediately," she said.

A CT scan at the emergency room showed a tumor at the back of her head.

"We just thought she needed glasses. We weren't thinking she had a brain tumor," Hailey's mom said.

From the emergency room, they sent her to Children's Mercy, where doctors put her in intensive care immediately to watch her blood pressure, which kept spiking, and put a drain in her head.

Doctors at Children's Mercy recommended surgery to remove the tumor.

Hailey spent time under the care of the Neurosurgery section where Christian Kaufman, MD and Gregory Hornig, MD, were her surgeons.

"It was very surreal, very emotional," Tricia Phegley said. "At that point they were just concerned with getting the tumor out. It was a huge relief that they were able to get it all and she didn't have any bleeding or complication."

The operation also took nearly half the time – six hours – than the 10 to 12 hours that Tricia Phegley and Hailey's dad, Dustin Phegley, had expected.

After pathology revealed a grade IV malignant medulloblastoma, three courses of chemotherapy, a stem cell harvest and three courses of high-dose chemotherapy followed by a stem cell rescue for each

was then recommended. The chemotherapy was intense but meant to treat her tumor while avoiding radiation due to her young age.

Kevin Ginn, MD, was Hailey's primary oncology doctor.

"He always made time to see and keep tabs on her," Tricia Phegley said. "He made sure we understood what to do about her and her treatment plan."

On the Way to Recovery

Dr. Ginn quickly asked Dr. Mohamed Radhi from the Bone Marrow Transplant Team to assist in Hailey's care. Dr. Ginn would administer the initial chemotherapy and then Hailey transitioned to the Team that specializes in high dose chemotherapy with stem cell rescue to intensify her therapy.

"The experience with the nurses and doctors was amazing and they took such good care of Hailey," Tricia Phegley said. "No matter where we were, they took exceptional care of her. The nurses on 4 Henson Tower treated us like family."

Moving Beyond

A year later, Hailey is in remission. She loves the color purple, playing with her stuffed monkeys and dolls, and with her older sister, Xandi. She likes dancing and gets excited about Minnie Mouse and the Care Bears.

A few setbacks from the high dosages of chemotherapy are now behind her and she has learned to walk, feed herself and adjust to life wearing hearing aids because of some hearing loss caused by the chemotherapy.

The experience also had a positive effect on Tricia's future and she is taking classes to pursue a health care career.

"Being around Children's Mercy staff made me want to be a nurse," she said.



➔ Radiology

Diagnostic radiology plays an important role in the care of the child with a brain tumor, which extends from the time of initial diagnosis through the continued monitoring of therapy. Imaging at the time of initial diagnosis allows for therapeutic planning and more precise intraoperative guidance for the surgeon.

Diagnostic imaging can effectively show tumor response to therapy and may suggest early recurrence during the monitoring of therapy. Commonly employed neuroimaging modalities include magnetic resonance imaging (MRI), computerized tomography (CT) and positron emission tomography (PET).

More advanced neuroimaging techniques, which may be performed at Children's Mercy, include perfusion imaging, tractography and functional MRI (fMRI). Advanced techniques such as these may also be utilized to guide therapy and improve patient outcomes. Although pediatric radiology examinations commonly require sedation, sedation can be avoided by utilizing our child life specialists or by watching a movie with DVD goggles during the scan to help the child feel more comfortable.

The ultimate goal of diagnostic radiology in the care of a child with a brain tumor is to provide the highest quality imaging for the diagnosis and treatment of brain tumors in an environment that is favorable for both the child and family.



Stem Cell Transplant Team →

At Children's Mercy, the stem cell transplant team works in close coordination with the Neuro-Oncology Team for brain tumor patients who may benefit from high dose chemotherapy with autologous stem cell rescue. After referral to the Stem Cell Transplant Team, the Neuro-Oncology Team continues to follow very closely in collaboration to ensure the coordination of care and therapy planning is optimized for each patient. The assigned Transplant physician becomes an integral part of the multidisciplinary team consisting of the Neuro-Oncologist, Radiation Oncologist, Neurosurgeon and other supportive staff to provide the highest level of clinical care.

The outcome for children with malignant brain tumors has improved in recent years, especially for those children with 'standard-risk' medulloblastoma and other primitive neuro-ectodermal tumors. For other children with newly diagnosed malignant brain tumors, especially in the absence of radical surgical resection, the outcome remains poor despite surgery, irradiation and conventional chemotherapy. Patients whose

tumors recur despite initial therapy continue to experience a dismal outlook with these conventional strategies of treatment. In an attempt to improve the outcome for brain tumor patients with poor prognoses, strategies utilizing high-dose (potentially myeloablative) chemotherapy with autologous stem cell rescue have been developed since the 1970s. Brain tumors are protected from systemic chemotherapy by the blood-brain barrier (BBB) and by intrinsic properties of the tumors. Steep dose-response curves of the cytotoxic alkylating agents exists, and when used in the myeloablative regimens might overcome the blood-brain barrier thereby improving penetrance of the tumor by cytotoxic drugs.

Advances in hematopoietic progenitor stem cell apheresis and rescue with peripheral blood progenitor cells or bone marrow (BM), and the availability of hematopoietic cytokines, have provided an opportunity to intensify doses of chemotherapeutic agents. With hematopoietic progenitor cell rescue, patients are able to tolerate repeat doses in shorter intervals, even after

craniospinal irradiation. These studies, conducted initially in patients with recurrent tumors, were then extended to patients with newly diagnosed malignant gliomas and brain-stem tumors, as well as to young children with various malignant brain tumors at diagnosis in an attempt to avoid irradiation to the brain. The results of several of these studies demonstrate durable disease-free survival for a proportion of patients with recurrent malignant gliomas and medulloblastomas/PNET, as well as encouraging data in some of those patients with newly diagnosed brain tumors.

Intensive chemotherapy with stem cell support has shown promise but is associated with significant toxicity. Tandem stem cell rescue schedules, often used in infants with CNS tumors, permit administration of increased dose intensity (greater cumulative doses per unit of time) with potentially better therapeutic ratio, but concerns remain about the toxicity of this regimen. Currently many clinical trials are testing the efficacy of tandem transplants for various brain tumors in children.

→ Neurosurgery



Neurosurgery is most often the first point of contact for a new patient with a brain or spinal cord tumor. After imaging has been obtained due to concerning symptoms and a tumor found, neurosurgery determines the best course of action for the patient. Immediate procedures may be needed for stabilizing the patient but another focus of surgery is to obtain tissue for accurate diagnosis. There have been great improvements in neurosurgical techniques, such as image guidance and microsurgical equipment, and it is thought that this advancement has been one of the main drivers to improved survival in pediatric neuro-oncology.

The neurosurgical team works in close collaboration with multiple services at Children's Mercy. Because of this collaboration we can provide optimal services for the children afflicted with brain tumors; the process begins at the time of admission, continues for the duration of treatment, and extends through long-term follow-up for many years as needed by the patient.

There are four neurosurgeons on staff and they are supported by three neurosurgery nurse practitioners, multiple clinic and floor nurses, and of course anesthesiology and other operating room staff.

The Neurosurgeons are all involved in the Brain Tumor Program planning and development and participate in the multidisciplinary patient-focused conferences to determine the safest approach for best outcomes for each patient. Gregory Hornig, MD, also provides coordination of care for those patients who need gamma knife radiosurgery at the Midwest Gamma Knife Center at Research Medical Center.

As an example the collaboration needed to care for a patient, we can look at the actual recent treatment provided to a 12-year-old patient with an astroblastoma.

The diagnosis of a brain tumor was made in 2007 on the basis of imaging done with our Radiology Department. Surgery was assisted with a navigational device based on images provided by the Radiologists. Expert ICU physician care and comprehensive nursing support was provided post-operatively. Follow-up MRI demonstrated complete surgical resection. Pathology made the diagnosis of astroblastoma, a relatively rare tumor. Our pathologists collaborated with outside reviewers to ensure an accurate diagnosis was made. The Oncology Team made

a recommendation for radiation therapy with our radiation oncologist, based on the final diagnosis.

After tumor recurrence, further surgery was needed and chemotherapy initiated by Oncology. Further support was provided by Endocrinology and Neurology for treatment of diabetes and seizures. The young lady, who remains normal neurologically, did not need the help of Rehabilitation, but such care was available as needed.

Administration was helpful in providing financial support and arranging insurance protection with outside providers.

The Neuro-Oncology Team will be following this young lady for an indeterminate period of time with continued monitoring of therapy related toxicity and recurrence with regular screening tests and labs and frequent MRI. Eventually she may transition to the Survive and Thrive Team for long-term follow-up and transition to adult care.

Above: Drs. John Clough, Gregory Hornig, Usiakimi Igbaseimokumo and Christian Kaufman



Pathology →

Children's Mercy has state of the art knowledge and laboratory equipment to provide answers to a large spectrum of diagnostic challenges.



Above: Dr. Eugenio Taboada

The pathologist is another key member of the Neuro-Oncology Team, and Eugenio Taboada, MD, a member of the Neuro-Oncology Team, works with a group of pathologists to ensure the best information is available for therapeutic decisions.

A pathologist is the physician (MD or DO) that specializes in the diagnosis of diseases by different laboratory methods. By examining the tumor tissue under the microscope the pathologist provides the diagnostic classification (the name and type) of brain tumors. Such information is one essential piece of the puzzle in planning adequate treatment, and an estimate of the prognosis or probable outcomes and probable behavior of the tumor or disease.

The pathologist participates in the multidisciplinary conference: Neuro-Oncology Tumor Board. In this conference the involved professionals of different clinical and patient care disciplines of the hospital get together to present and discuss diagnosis, management and treatment challenges posed by a patient with cancer or brain tumor. The pathologist

presents the diagnosis and disease findings of particular patients, which is an essential part of the discussion and evaluation of patient's care. A network of expert opinions locally, nationally or even internationally is also readily accessible if needed.

The pathologist also works with a group of laboratory professionals providing answers and important information using state-of-the-art diagnostic technologies such as immunohistochemical, molecular genetics and other laboratory methods. Children's Mercy has state of the art knowledge and laboratory equipment to provide answers to a large spectrum of diagnostic challenges.

The results of the diagnostic information are utilized by the oncologist and Patient Care Clinical Team to decide the most appropriate treatment and clinical plan for a particular patient. Thus, the participation of the pathologists and laboratory professionals in patient care continues to be essential in current times.

Alicia's Adversity: Overcoming JPA Despite All Odds

When Shelley's seven-year-old daughter, Alicia, began experiencing severe neck and shoulder pain, lethargy and vomiting, Shelley knew something was wrong.

Visits with several pediatricians yielded ineffective treatments and inaccurate diagnoses, all of which ended in Alicia not getting better.

"I took her to several doctors, but none of them could figure out what was wrong with her," said Shelley of Tonganoxie, Kan. "One doctor said it was just allergies."

Dissatisfied with the diagnoses, Shelley tried a new pediatrician who ordered an MRI. Two

days later, a phone call delivered Shelley terrifying news: her daughter had a brain tumor.

Plan of action

"The doctor told me to take her to Children's Mercy immediately," Shelley said. "She didn't even offer me a choice because I don't think there was any question in her mind where the best place for Alicia to go was."

Alicia was admitted and prepped for brain surgery in a matter of days.

"I was so scared when I first came to the hospital," Alicia said. "I remember my mom was allowed to come in the operating room and stay with me until I fell asleep and that meant a lot to me."

"Alicia had a juvenile pilocytic astrocytoma (JPA) of her cerebellum, the back part of the brain that controls coordination," said Maxine Hetherington, MD, Pediatric Hematologist/Oncologist at Children's Mercy. "Most JPAs are easily removed with surgery, but her tumor was atypical and much more difficult to control."

Despite all odds, Alicia survived the surgery. However, she was in a coma for six weeks and lost all of her motor skills.

"No one knew if I could understand them," Alicia said. "It was frustrating not being able to communicate. I couldn't even blink my eyes."





→ Survive and Thrive

After the completion of therapy for a brain tumor, patients are initially followed closely by their primary treatment team. After at least two years of being off therapy, patients may then transfer to the Children's Mercy Survive and Thrive Clinic. The patient's history, including diagnosis and previous therapies, is closely analyzed to determine what each individual patient's long-term risks are, then a plan is developed for close monitoring.

The Survive and Thrive clinic is a multidisciplinary clinic that monitors for late effects of cancer therapy and promotes a healthy lifestyle to prevent development of late effects. Approximately three out of four childhood cancer survivors develop one or more health problems and 25 percent of these complications may be severe or life threatening. During a clinic visit each patient and their family meets with a nutritionist, social worker, nurse educator and physician. Clinic visits are coordinated so patients also obtain screening studies such as hearing tests on the same day.

This year we have also added a combined clinic with endocrinology, which allows families to follow-up on previously identified endocrinopathies or to obtain screening for the development of additional hormone deficiencies. Patients who have received treatment for a brain tumor are at high risk of developing a hormone deficiency due to the location of their tumor, treatment with radiation, and/or surgery. Providing this coordination decreases the burden of travel and time away from work/school on the families.

Above: Children's Mercy employees and their families at the 2013 CureSearch Walk

She continued, "I remember my mom and the doctors were around my bed talking about my cat and a tear rolled down my eye. That's when they knew I could hear."

One Step at a Time

As Alicia recovered, she began physical therapy at the hospital.

"The therapists at Children's Mercy were great," Alicia said. "They gave me tools to help me communicate better and made me more comfortable."

When Alicia moved her finger for the first time, there was a huge celebration.

But despite all her progress, it was unlikely Alicia would be able to walk or talk again.

Resolve to Defy the Odds

"I knew I was going to prove them wrong," Alicia said. "I was determined I was going to walk again."

Over the next five years, Alicia attended physical therapy sessions at the Rehabilitation Institute of Kansas City. At the same time, she underwent chemotherapy, radiation and steroid treatments at Children's Mercy.

Throughout the course of her treatment and therapy, Alicia had six reoccurrences of her brain tumor and they required three additional brain surgeries.

Now recovered and leading a very normal life, Shelley said she owes Alicia's life to Children's Mercy. "We're extremely lucky Alicia was here at Children's Mercy," she said. "In all the years she was here, we never felt the need to go elsewhere for a second opinion."

Saying Goodbye

Today, 23-year-old Alicia lives with minimal physical limitations.

She is now a part of the Survive and Thrive program at Children's Mercy and is preparing to manage her own health as she transitions to an adult health care provider.

Alicia is pursuing a degree in elementary education from the University of St. Mary in Leavenworth and recently passed her entry exam for the school's teaching program.

Although it's hard for Alicia to say goodbye to Children's Mercy, it's easy for her to say thank you.

"Children's Mercy changed my life," she said, holding back tears. "It's just a great hospital. I already miss Children's Mercy."

Still Part of the Mercy Family

Alicia may have ended her time at Children's Mercy as a patient, but she is only beginning her time as a hospital volunteer.

Alicia's mother, who is already a volunteer, said she's excited they can volunteer together—to give back to the hospital that forever changed their lives.



Dr. Julia Broussard

→ Endocrinology

Children diagnosed with brain tumors are at high risk for multiple endocrinopathies due to their cancer treatment which is often a combination of surgery, radiation and chemotherapy. For example, patients who had cranial radiation are at high risk for growth hormone deficiency, delayed or early puberty, infertility, hypothyroidism, adrenal insufficiency, compromised bone health and obesity.

In fact, endocrine abnormalities are the most common late-effects seen in the long-term follow-up of childhood cancer survivors. That is why Division of Endocrinology developed a focused clinic for these patients – the Endocrine Disorders in Cancer Survivors clinic (EDICS Clinic) run by Sripriya Raman, MD and Julia Broussard, MD.

Since the establishment of the brain tumor program, referral of high-risk patients to endocrinology has been streamlined and made seamless. All patients coming through the EDICS Clinic are risk stratified based on their comprehensive cancer treatment summary, educated on their current endocrinopathies

and future risks, treated, and followed closely as needed. Difficult patient situations are discussed either informally between members of the brain tumor team or formally through regularly scheduled case conferences. Every effort is made to ensure smooth planned transition of older patients from pediatric endocrinologists to adult providers.

Our quarterly EDICS Transition Clinics began in October 2013. Soon we will start our EDICS Telemedicine Clinic, which is aimed to minimize the barriers of distance for patients who live far away from our hospital with the help of the exciting and growing technology of telemedicine.

It is clear that, in the years to come, the brain tumor team will continue to grow strong and effective in delivering excellent clinical care and nurture significant projects addressing important research gaps. Overall, as an integral part of the brain tumor team, we take pride in working hard to improve the standard of care for these patients and families.

→ Nursing



Nurses play a vital role in the care of pediatric patients with brain tumors at Children's Mercy. The Neuro-Oncology Clinic has a dedicated nurse who has a specific interest in caring for patients with brain tumors, but there are many oncology trained nurses who help care for our patients. The nurses in clinic obtain labs, perform initial assessments, administer chemotherapy and medications, and provide important teaching to the patients and their families. Our patients develop strong, supportive relationships with their nurse who is an important part of the care team.

On 4 Henson, the Hematology-Oncology floor in the hospital, the inpatient nurses are also specially trained to provide care in oncology and they perform many similar functions that clinic nurses perform, but 24 hours a day. The patients on the floor can be critically ill at times or can be post stem cell rescue, requiring much closer monitoring.

There are also nurses throughout the hospital who are important in the care of our patients in areas such as Radiology, where they assist with the various procedures needed by the brain tumor patients. These nurses can include the sedation nurses, who help sedate patients for scans such as MRI and CT scans. There are also nurses in the Interventional Radiology Department who assist the radiologists with placement of central lines or gastrostomy tubes, which are very important in the treatment of some of our patients.

Finally, there is a dedicated nurse practitioner within the Neuro-Oncology program. The nurse practitioner works as a case manager to

coordinate the care of brain tumor patients. This includes coordinating appointments with multiple departments such as neurosurgery, radiation oncology, ophthalmology, endocrinology, rehabilitation and audiology. The nurse practitioner also provides extensive teaching for families and is available to families by phone during the week when parents have questions or concerns. The nurse practitioner sees patients at their normally scheduled clinic visits, and sees patients urgently when they become ill. The nurse practitioner also helps with authorizations with insurance companies and arranging home health. After normal business hours and on weekends, a nurse practitioner is always on call to provide 24-hour support to our patients.

Nurses are involved with brain tumor patients from initial diagnosis through treatment and even after treatments are completed. A nurse is even involved in managing our Long-Term Follow-Up Clinic where brain tumor patients are seen once their chemotherapy is completed to manage long-term complications.



→ Family Care Team (FaCT)



Multidisciplinary care is integral to the overall outcomes and well being of our patients. Outside of cancer directed care, families and patients have many other needs that are often addressed by our Family Care Team. Regular FaCT Team Rounds ensure that all disciplines involved communicate patient needs and provide support to our families.

Child Life Specialists help make the hospital more comfortable, easier to understand, and fun for patients and families. Child Life tries to reduce the stress and worry that may come with being in the hospital, or from being ill, by preparing patients and families for upcoming procedures and helps them through the procedures using distraction, comfort positioning and empowering the patients by giving them realistic choices when available. Child Life also helps children cope with their feelings, thoughts and questions, as well as learn and grow while still in the hospital through normal developmental play and medical play.

Ten **clinical social workers** are a part of the primary team working with patients and their families

in the Division of Hematology and Oncology at Children'sMercy. There is a specific clinical social worker, Caroline Bearden, who is part of the Neuro-Oncology team. The social workers understand that any change in a child's health can alter a family's life in many ways. Social workers are licensed professionals trained to address the needs of the patient and their family. Social workers help with therapeutic support including adjustment to illness, bereavement, crisis intervention, parent child interactions and sibling support. Care planning including education on advanced directives, school issues, legal issues and transition to adult care are addressed as well. Finally, social workers can help with community referrals to assist with financial concerns, transportation issues and mental health

referrals. The social workers help the family develop coping skills from the point of diagnosis through the end of treatment and beyond.

Music therapy services are offered to patients and families at bedside to address the specific needs of each individual. Music interventions are designed and planned after an assessment of need and generally involve the use of both live vocal and instrumental music. Children are encouraged to take an active role in making music.

The Parent to Parent Program works hard to continue providing support services for our families. There are many programs offered through the PTP program, including: trained parent mentors available to share, listen and support our current



parents; a stocked parent room that offers weekly dinners, breakfasts, therapeutic activities and a safe place to unwind while a child is inpatient on 4H; and “care packages” for the new families shortly upon admission to help ease some burden of a hospital stay.

The Hematology/Oncology/Bone Marrow Transplantation **chaplain** is available to meet every new patient and their family, who are inpatient and introduce them to chaplaincy services offered at Children’s Mercy. The family’s own clergy will be contacted if requested. Chaplains can also assist with locating a local clergy person of their denomination or faith if the family is from out of town. The chaplain continues to support families throughout treatment.

Two **psychologists** assist with the mental health challenges that present when under treatment for a brain tumor. They are available to meet individually with the patients and their families. The psychologists complete neurocognitive testing to aid patients in making sure their education needs are met. They also monitor the effects of therapy on cognition over time.

One **school teacher** is onsite to assist patients on the inpatient unit and outpatient clinic with the challenge of keeping up with school work while undergoing treatment. Our school teacher is able to communicate directly with the child’s school to receive current assignments and to advocate for the patient’s needs once they return to the school setting.



Terrie Flatt, DO → Spanish Clinic



Terrie Flatt, DO, was studying in Mexico when he became ill with a parasitic infection and went looking for care at a rural clinic. It was early in his education, which focused on the Spanish language and anthropology, when he discovered the communication barrier created a stressful situation as he sought treatment.

"You don't know what it's like until you have been in a health care situation and do not speak the language," said Dr. Flatt, who has lived in Latin America and Mexico and taught Spanish at the university level for 10 years. "When I decided to go to medical school, that experience stuck in my mind," he said. "I can only imagine what it is like when it is really significant. My experience was nothing compared to what these children go through."

With that experience prominent in his memories, Dr. Flatt helped to form the Children's Mercy Spanish-

Speaking Hematology/Oncology Clinic, which opened in the summer of 2012. Its mission is to better address the health needs of the region's Spanish-speaking community.

The clinic weaves Dr. Flatt's medical training with his background in anthropology and Spanish. Prior to Children's Mercy, Dr. Flatt lived in south Texas where most care givers and patients/families spoke Spanish. He noticed that Spanish-speaking patients seemed more easily to assimilate into the medical environment.

When he came to Children's Mercy he discovered a need for that access to bilingual caregivers.

"I said 'this is an opportunity to help people,'" Dr. Flatt said. "There are so many levels of understanding and this allows a doctor to have a relationship with the patient that you can't have through an interpreter alone."



Dr. Flatt has started a system that provides patients with medication information in English and Spanish so the patient and any other physician would know what the patient has been prescribed. "That way I know with certainty that there won't be a breakdown in language that could hinder medical care in complex patients," he said.

The population of Spanish-speaking families at Children's Mercy mirrors the demographics of Kansas City at 10 to 15 percent. In 2012, four patients with brain tumors were of Spanish/Hispanic origin, according to the Children's Mercy Medical Records department.

"For me it's about communication," Dr. Flatt said. "That's a large diversity of people and establishing a meaningful relationship and acknowledging the differences toward health helps patient's physical, emotional and spiritual well-being."

Dr. Flatt's goals for the clinic include expanding a telemedicine outreach effort and creating a support group for Spanish speakers.

"We are striving to increase the outreach to rural areas for Hispanic consultation and working with general practitioners," Dr. Flatt said. "We are forming parent groups for cancer patients and their families so they can get together with social workers and other professionals, and families can voice the obstacles they face in seeking medical care. We will also provide general educational support."

Dr. Flatt's research in children's leukemia is also targeting this population. He will use the samples from local Hispanic patients who agree to participate while reaching out to other research sites in the United States and in Mexico.

"We are in the process of establishing a relationship with a children's hospital in Mexico," he said. "We are looking for genetic differences in the leukemia cells as related to ethnicity."

The project is in the development phase.

"The ultimate goal of a project like this, which will take years to achieve, is to determine if patients with certain genetic rearrangements may need more intense therapy, or perhaps we may find a targeted drug for some of these genetic alterations," he said. "The hope is to have better cure rates for this population."



Linda D. Cooley, MD, MBA → Cytogenetics

Linda Cooley, MD, MBA, and personnel at the Cytogenetics Laboratory see daily how a person's genetic makeup can determine the best cancer treatment.

Dr. Cooley's lab is an accredited clinical testing laboratory that uses microarray technology from Affymetrix to look at a patient's genes and find clues as to how to best handle their disease. A typical test for interpreting the genome comes from a small blood sample, from which the DNA from the blood is isolated, fragmented and labeled.

"The Affymetrix HD Cytoscan makes it possible to screen the entire genome for variations or changes," Dr. Cooley said. "The system has the capability of detecting different kinds of genetic variations by using differently designed 'chips,' small pieces of glass that

have fragments of DNA attached. The DNA fragments are designed to match normal pieces of DNA in the genome. On the chip we are using, there are 2.7 million pieces of DNA on the glass."

An analysis can indicate differences in genetic material and mutations that can mean risk of disease.

"The newer microarray technologies (like Affymetrix) allow us to see a lot more of the details of the genome," Dr. Cooley said. "In cancers with certain abnormalities of genes, drugs can be designed to specifically target the abnormality. By knowing the genetic makeup and what's happened we can create drugs to target abnormalities and have a much better rate of response and higher cure rate."



*Above: Actors Rob Riggle, Paul Rudd and Jason Sudeikis returned to Kansas City for the annual **Big Slick Celebrity Event**, which benefits Children's Mercy.*

The lab purchased the Affymetrix HD Cytoscan System with funds donated to the Hematology/Oncology/Bone Marrow Transplantation division from last year's event.

The newfound abundance of genetic information is now being employed to advance therapies.

"With the Affymetrix system, we are initiating testing of different kinds of samples, (bone marrow, tissues and tumors), with the goal of detecting and characterizing variations in the DNA of various types of cancer," Dr. Cooley said.

In the larger scope of population genetics, application of this new technology may be used to indicate and treat certain diseases in populations and ethnic groups.

"We inherit our genes from our ancestors and depending on what part of the world we come from, there will be some minor differences in the DNA," Dr. Cooley said. "Minor differences in a gene

or the genetic material can have an affect on how an individual's body uses a certain drug. The same drug might work quickly or effectively in one person, but may work slowly or not work well for another person. By examining the DNA for variations, there is the possibility of identifying why one ethnic group fairs better than another ethnic group treated with the same drug therapy."

The lab purchased the Affymetrix HD Cytoscan System with funds donated to the Hematology/Oncology/Bone Marrow Transplantation division from last year's annual Big Slick Celebrity Event.



Kathleen Neville, MD, MS Experimental Therapeutics



It's been only four years since the Experimental Therapeutics in Pediatric Cancer Program began at Children's Mercy, but the program has already exceeded expectations, according to Director Kathleen A. Neville, MD, MS.

"The reception by the community has been phenomenal," said Dr. Neville, who is board certified in hematology/oncology and pharmacology. "We've already exceeded our five-year goals."

Program doctors, nurses and nurse practitioners meet with patients from across the region and country, and even do international consultations that use early phase cancer drugs, including those for brain tumors.

"This year the program participated in about 25 studies and several others are in the pipeline," Dr. Neville said. "Some trials are specifically for brain tumors and some trials are for all solid tumors with the intention

of treating brain tumors. Trials specifically for brain tumors are an area that we will continually build. We're very happy to have a dedicated brain tumor program, as many brain tumors are a challenge to treat."

The program collaborates locally with the Institute for Advancing Medical Innovation at the University of Kansas and consortia from across the country and North America.

Building on the hospital's internationally recognized expertise in clinical pharmacology, Experimental Therapeutics serves as the clinical pharmacology core for the Pediatric Oncology Experimental Therapeutics Investigators' Consortium and the Neuroblastoma Medulloblastoma Treatment Research Consortium.

Treating a child, while minimizing toxic effects on development, growth or function, and maintaining quality of life is one of the program's main objectives.



"The end goal is to find better ways that treatments can be translated for children while finding drug companies that will manufacture them," Dr. Neville said.

Another challenge with pharmacology is how different children metabolize drugs. Some drugs can affect growth and there can be more toxic effects when children are given brain tumor drugs than for adults because of their developing brains.

"I'm always saying this, but children really aren't small adults. It's like treating two different populations."

The program's success lies in the selflessness of families and patients who agree to participate, adds Dr. Neville.

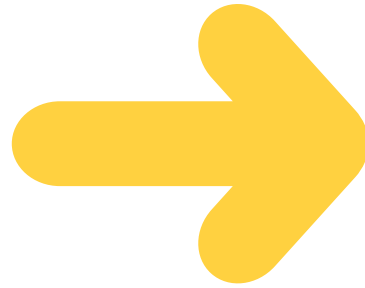
"They come for services at a time when things can be pretty grim and they do it with empathy and

sympathy for other children and families because their own child is not likely to survive."

Seeing how patients' families give with grace and gratefulness motivates Neville and her colleagues' work.

"Our patients and their families inspire us to push forward in our battle to find better treatments – and better ways producing and delivering those treatments – to help children not only here in our region, but around the world."





Research

Parent Satisfaction in an Outpatient Bone Marrow Transplant Clinic

Funder: Alex's Lemonade Stand

PI: Nancy Shreve

Outpatient care of children who have received a bone marrow transplant is complex and challenging. During the post transplant recovery period, complications often arise that affect prognosis, require treatment decisions or changes in interventions, and/or re-hospitalization. The parents of these children have multiple stressors as they take on new responsibilities of monitoring for complications, administering complex medication regimens and performing unfamiliar procedures. Lengthy and frequent clinic visits can create additional stressors as parents try to balance home and work commitments. A better understanding of parents' needs and concerns during this time is a first step in understanding how to positively contribute to their satisfaction with their outpatient bone marrow transplant experience. For this two-part study, researchers conducted focus groups to understand parental perceptions of the process. This information was then used to create a tool that is being tested as a measurement of satisfaction.

Effects of Intrathecal Methotrexate on Folate Metabolism in the Cerebrospinal Fluid of Children with Acute Lymphoblastic Leukemia

Funder: Children's Mercy Hospital's Katherine Berry Richardson Grant

PI: Keith August, MD

Chemotherapy given into the cerebrospinal fluid (CSF) is an important part of therapy for patients diagnosed with acute lymphoblastic leukemia (ALL) and non-Hodgkin's lymphoma (NHL). It helps to prevent a relapse in the central nervous system. One medicine commonly used for this purpose, methotrexate, sometimes can have long-term effects that include subtle changes in behavior and intelligence. It is not well understood how giving methotrexate into the CSF causes these symptoms and what other factors may put patients at risk for side effects. How the drug affects folate levels is one possible key. Researchers are studying the CSF before and after methotrexate is given to learn more about the causes of neurologic side effects associated with methotrexate.



Elongation Factor Protein in ALL

**Funder: Midwest Cancer Alliance Partners
Advisory Board Funding**

PI: Erin Guest, MD

**In collaboration with researchers at
The Stowers Institute**

The identification and development of effective treatments for malignancies requires a thorough understanding of the basic mechanisms of how cancer develops. Researchers are doing this study to see how proteins and genes interact inside of leukemia cells. We think this will help us better understand how leukemia develops. This study will look for differences in proteins and genes inside of leukemia cells in blood and/or bone marrow, compared to healthy white blood cells. Understanding these differences may help us find better treatments for leukemia.

Pediatric Formulation of Chemotherapy

**Funder: Midwest Cancer Alliance Partner's
Advisory Board Funding**

PI: Kathleen Neville, MD

**In collaboration with researchers at The
University of Kansas**

Many of the drugs used to treat children with cancer come in forms that are not always child friendly. For children who cannot swallow pills or capsules, this creates issues. Through the years, doctors have tried things like crushing and mixing these drugs to get them in a form children can take. Research is lacking to show that these methods are as useful as the original form. Researchers in this study are looking at how we can create child friendly versions of chemotherapy drugs that we know are as effective as the originally available commercial version.



Immunotherapy for GD2 Positive Tumors

Funder: Midwest Cancer Alliance Partner's Advisory Board Funding

PI: Doug Myers, MD and Joy Fulbright, MD

In collaboration with KU and Baylor College of Medicine

As tumors of neuroectodermal origin, the cancers neuroblastoma and melanoma express cell surface proteins not found on most tissues in the human body. These proteins are of interest to physicians as potential targets for tumor specific immunotherapeutics. Both neuroblastoma and melanoma have the surface protein called GD2. Researchers in this study are growing cells with the ability to recognize GD2 on cancer cells and kill it. In the laboratory, we have found that T-cells that are trained to recognize common viruses can stay in the blood stream for many years. By joining the anti-GD2 antibody to T-cells that recognize and kill viruses, our researchers believe that we will also be able to make a cell that can last a long time in the body, provide protection from viruses and recognize and kill cancer cells.

Bridging the Gap

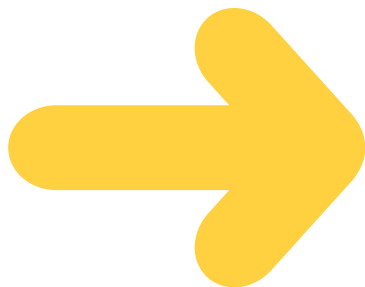
Funder: Midwest Cancer Alliance Partner's Advisory Board Funding

PI: Sripriya Raman, MD

In collaboration with KU

The improvements in the treatment of childhood cancer have led to an increased number of childhood cancer survivors in the United States. Pediatric and adult survivors of childhood cancer are at risk for late effects or health problems that can present and/or persist several years after the completion of treatment and potentially affect any organ system in the body. The need for long-term follow-up care of childhood cancer survivors has been well established and guidelines now exist to help providers monitor for late effects of treatment. However, there continues to be a knowledge gap among health care providers in several topics related to monitoring and early diagnosis of long-term effects of cancer treatment. The goals of this project are to assess health care providers' knowledge of the unique needs of childhood cancer survivors, develop a face-to-face meeting and web-based educational series with

providers to improve that knowledge, and evaluate performance improvement strategies among selected clinical sites. The program will also enable primary care providers and subspecialists to develop a network and collaborate more effectively in caring for childhood cancer survivors.



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