

**PEDIATRIC NEURO-ONCOLOGY FELLOWSHIP  
PROGRAM DESCRIPTION  
DEPARTMENT OF PEDIATRICS  
MEMORIAL SLOAN-KETTERING CANCER CENTER  
NEW YORK, NEW YORK**

**A. PROGRAM DEMOGRAPHICS**

- 1. Name of Host Institution:** Memorial Sloan-Kettering Cancer Center
- 2. Program Subspecialty:** Pediatric Neuro-Oncology
- 3. Program Address (mailing):** Memorial Sloan-Kettering Cancer Center, 1275 York Ave, Box 565, New York, NY 10065
- 4. Program Address (physical location):** Memorial Sloan-Kettering Cancer Center, 1275 York Ave, New York, NY 10065
- 5. Program Phone Number:** (212) 639-5966
- 6. Program E-mail:** [merkelk@mskcc.org](mailto:merkelk@mskcc.org)
- 7. Program Director:** Yasmin Khakoo, MD
- 8. Alternate Program Contact:** Stephen W. Gilheeney, MD, MMS
- 9. Program Administrator:** Katlyn Merkel

**B. INTRODUCTION**

- 1. History:** The program began in 2004. Seven fellows have successfully completed the training program since its inception.
- 2. Duration:** 1 year (12 months)
- 3. Prerequisite training/Selection Criteria:** Applicants must have completed their residency training in pediatrics and fellowship training in pediatric hematology/oncology or child neurology. Foreign applicants with equivalent qualifications are also eligible to apply.
- 4. Goals and Objectives for Training:** The aim of the Pediatric Neuro-Oncology Fellowship is to train the fellow to effectively evaluate and manage children and young adults with benign and malignant tumors of the central nervous system (CNS). Fellows will become comfortable with the diagnosis and management of complications of treatment of CNS tumors. Child neurology trained fellows will also receive training in the neurologic complications of cancer. In addition, fellows should become familiar with clinical and/or basic science research techniques if time permits.
- 5. Program Certifications:** Fellows may be eligible to become board certified in Neuro-oncology through the United Council for Neurologic Specialties (UCNS).

## C. RESOURCES

**Teaching Staff:** **Ira Dunkel, MD**, Attending, Department of Pediatrics; **Kim Kramer, MD**, Associate Attending Department of Pediatrics; **Yasmin Khakoo, MD**, Associate Attending Pediatric Neurologist, Departments of Pediatrics and Neurology; **Kaleb Yohay, MD**, Assistant Attending Pediatric Neurologist, Departments of Pediatrics and Neurology; **Stephen Gilheeny, MD, MMS**, Assistant Attending, Department of Pediatrics; **Kevin De Braganca, MD**, Instructor, Departments of Pediatrics and Neurology; **Mark Souweidane, MD**, Director, Pediatric Neurosurgery, Attending, Department of Neurosurgery; **Jeffrey P. Greenfield, MD, PhD**, Assistant Attending Department of Neurosurgery; **Suzanne Wolden, MD**, Attending, Department of Radiation Oncology, **Andrei Holodny, MD**, Chief, Neuroradiology Service; **Eric Lis, MD**, Associate Attending, Neuroradiology, Department of Radiology; **Sofia Haque, MD**, Assistant Attending, Neuroradiology, Department of Radiology; **Marc Rosenblum, M.D.**, Department of Pathology, Chief, Neuropathology and Autopsy Service, Department of Pathology; **Jason Huse, MD, PhD**, Department of Pathology; **Lisa DeAngelis, M.D.**, Chairman, Department of Neurology; **Thomas Kaley, M.D.**, Fellowship Director, Department of Neurology.

1. **Facilities:** Memorial Sloan-Kettering Cancer Center, 1275 York Ave, New York, NY 10065

## D. EDUCATIONAL PROGRAM – BASIC CURRICULUM

1. **Clinical components:** The Pediatric Neuro-Oncology Program at Memorial Sloan-Kettering Cancer Center is one of the largest in the country, with approximately 150 new cases per year. The fellow will participate in the pediatric neuro-oncology clinic, seeing patients for follow-up as well as evaluating new patients with the attendings. The fellow will also participate in the evaluation and management of hospitalized patients on the Pediatric Neuro-Oncology Service and related inpatient consults. Fellows will also be asked to take part in mail-based reviews that have been sent to the department faculty. In addition, the fellow participates in teaching residents and medical students who are doing rotations on the Pediatric Neuro-Oncology Service. The treatment of children and young adults with CNS tumors at Memorial Sloan-Kettering Cancer Center utilizes a multidisciplinary team approach.
2. **Participants supervisory and patient care responsibilities:** The Pediatric Neuro-Oncology team consists of pediatric neuro-oncologists, pediatric neurologists, nurse practitioners, neurosurgeons, radiation oncologists, neuro-radiologists and neuropathologists. The fellows are exposed to each of these disciplines with each patient, which leads to a more complete understanding of the individual types of CNS tumors. Fellows are expected to gain a thorough understanding of the clinical presentation and evaluation of pediatric CNS tumors, as well as treatment options, complications of treatment and long-term survivor follow-up.
3. **Procedural requirements:** Fellows will perform lumbar punctures, Ommaya reservoir taps, bone marrow aspirates and bone marrow biopsies on outpatients under attending supervision.

#### 4. Didactic components:

Name	Frequency	Trainee Attendance Required		# People Attending		Educational Objectives
		Yes	No	Trainees	Faculty	
Pediatric Grand Rounds	Weekly	X		15	20	Subject-specific education through weekly guest lecturers
Pediatric Neuro-Oncology team meeting	Weekly	X		1	10	Multidisciplinary meeting to review and plan patient care
Pediatric Neuro-Oncology Tumor Board	Weekly	X		10	10	Multidisciplinary discussion of newly diagnosed and other select patients
New York City Pediatric Neuro-Oncology Tumor Board	Quarterly	X		20	25	Multidisciplinary discussion of select patients with colleagues from other centers
MSKCC Adult Neuro-oncology Lecture series	Weekly			10	5	Weekly lecture series and monthly journal club to review basics on Neuro-oncology in the beginning of the year and then higher level topics (trial design, experimental therapeutics etc.)
MSKCC Brain Tumor Center Retreat	Yearly	X		25	50	Multidisciplinary educational conference reviewing current diagnosis, treatment, understanding and management of Neuro-oncology in clinical and basic science arenas
MSKCC Brain Tumor Center Lecture Series	Weekly from Sept-June	X		25	40	Multidisciplinary review of clinical and basic science Neuro-oncology in both Pediatrics and Adult Oncology
Comskil: communication skills building laboratory	2 full days per year	X		15	10	Learning effective communication in oncology through role playing. Topics covered include breaking bad news; the angry patient; and transitioning to palliative care
MSKCC Neuropathology Conference	Monthly from Sept-June	X		15	20	Review neuropathology cases seen at MSKCC; Recognize the importance of whole genome arrays, specifically as they relate to the treatment and prognosis of medulloblastoma

#### 5. Progression by PGY level: not applicable

#### E. EVALUATION

At the beginning of the academic year, the new fellow will meet with the attendings of the Pediatric Neuro-Oncology Team to review the overall objectives of the program as well as individual expectations of the fellow. The fellow will review the evaluation form with the attendings to indicate what specific areas they will actually be evaluated on. The fellow will be evaluated after six months and at the completion of the fellowship by the attendings. Records of each evaluation are maintained on file in the Pediatric Education Office (see attached copy of a standard evaluation). Any performance issues, which arise during the course of the fellowship, will be addressed by the program director(s). Fellows complete the standard Memorial Hospital forms to anonymously evaluate the individual attendings as well

as the program. The feedback received is discussed by the service and is used to strengthen the education program.

This fellowship program is evaluated internally by the Graduate Medical Education Committee (GMEC has oversight of all training programs for physicians) every three years.

Yasmin Khakoo, MD  
Program Director,  
Pediatric Neuro-Oncology Fellowship

Stephen W. Gilheeny, MD, MMS  
Associate Director,  
Pediatric Neuro-Oncology Fellowship

## ATTACHMENT

### Educational objectives

Clinical and theoretical knowledge: the fellow is expected to learn the following (adapted from the American Board of Pediatrics subspecialty curriculum):

*a. Epidemiology/predisposing factors/genetics*

Know the cytogenetic and molecular genetic abnormalities associated with brain tumors

Recognize the association between brain tumors and heritable syndromes (eg, neurofibromatosis, tuberous sclerosis)

Know the association between pineoblastoma and retinoblastoma

*b. Pathology*

Recognize the pathologic subtypes of brain tumors relative to prognosis, primary tumor site and pattern of spread

Recognize the relationship between histologic grade of gliomas and prognosis

*c. Clinical presentation*

Recognize the clinical presentation of brain tumors by anatomic site

Perform a competent neurologic assessment and be able to localize the lesion

Understand the clinical and pathologic characteristics of pediatric brain tumors

Know the clinical and laboratory manifestations of different central nervous system tumors

Know the clinical and laboratory features of medulloblastoma, cerebellar astrocytoma, brain stem glioma, pineal tumors, ependymoma, primitive neuroectodermal tumors and optic pathway gliomas

Recognize the relationship between age and anatomic site in the clinical presentation of brain tumors

*d. Diagnosis and staging*

Utilize appropriate imaging modalities to determine the extent and metastatic spread of brain tumors

Know which central nervous system tumors are associated with spinal cord metastases

Know the cerebrospinal fluid findings associated with medulloblastoma

Know how to utilize imaging modalities to characterize medulloblastoma, astrocytoma, brain stem glioma, pineal cell tumors, ependymoma and primitive neuroectodermal tumors

Know the patterns of metastasis and spread characteristic of medulloblastoma, low grade astrocytoma, ependymoma and primitive neuroectodermal tumors

Know which central nervous system tumor is most likely to metastasize outside the central nervous system

Know how to utilize imaging modalities to characterize optic pathway gliomas

Know the patterns of metastasis and spread characteristic of glioblastoma multiforme

*e. Treatment*

Know the role of surgery in the treatment of brain tumors

Recognize that surgery alone is curative for cerebellar astrocytoma

Know the role of irradiation in the treatment of brain tumors

Know the role of chemotherapy in the treatment of brain tumors

Monitor the response to treatment of brain tumors using clinical modalities, imaging modalities, biochemical markers and histologic markers.

Know the principles of management for patients with medulloblastoma, low grade astrocytoma, brain stem glioma, pineal tumors, ependymoma, primitive neuroectodermal tumors, high grade gliomas (anaplastic astrocytoma and glioblastoma multiforme) and central nervous system germ cell tumors

*f. Prognosis*

Know the prognostic features of brain tumors

Know the prognosis of brain tumors according to stage and histology

Know the natural history of medulloblastoma, low grade astrocytoma, brain stem glioma, pineal cell tumors, ependymoma, high grade gliomas and primitive neuroectodermal tumors

Identify the prognostic factors in patients with medulloblastoma, astrocytoma, brain stem glioma, pineal cell tumors, ependymoma and primitive neuroectodermal tumors

Identify the prognostic factors in patients with central nervous system germ cell tumors

*g. Complications/late effects*

Know the acute complications of treatment of CNS tumors including deep venous thromboembolism; neutropenia, thrombocytopenia, and anemia; and CNS and systemic infections

Know the use of blood products and growth factor support

Know the late effects of brain tumors and their treatment in patients of various ages

Know the secondary malignancies associated with treatment of brain tumors

Know the potential neurologic, endocrine, intellectual sequelae of brain tumors and their treatment

Know the complications and late effects of surgery, irradiation and chemotherapy performed in the treatment of brain tumors

Know how to implement pain management strategies for headache, increased intracranial pressure and treatment related peripheral neuropathy

Know how to transition patients to palliative and end-of-life care

*h. Additional competencies for fellows may include:*

Know the treatment of metastatic cancer to the nervous system including brain and spinal cord metastases; base of skull metastases; leptomeningeal metastases; epidural metastases and spinal cord compression; and plexus and peripheral nerve metastases

Know the evaluation, diagnosis and management of systemic cancer-related neurologic disorders including:

1. Adverse events and reactions to surgical, medical, and radiation treatment of neuro-oncology patients
2. Toxic, nutritional and metabolic encephalopathy
3. Cerebrovascular disease
5. Seizures
10. Neuro-oncologic complications of bone marrow transplantation
11. Paraneoplastic syndromes