

Strengthening Neuro-Oncology Training in China: Current Status and Opportunities

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Abstract

This review examines the current status and future opportunities for strengthening neuro-oncology training in China. With the rising burden of gliomas, brain metastases, and other central nervous system tumors, there is an urgent need to cultivate specialized clinicians capable of addressing the complexity of modern neuro-oncological care. However, existing training models in China, primarily rooted in general neurosurgery, are insufficient for preparing physicians for the interdisciplinary demands of neuro-oncology, which span neurology, oncology, radiation therapy, and molecular pathology. Drawing on established frameworks from the United States and Europe, the review proposes a China-specific roadmap that includes launching standardized fellowship programs, developing competency-based curricula, and integrating training with clinical research platforms. It also highlights the potential of continuing education, online learning, and international collaborations to supplement formal training and address regional disparities. Emphasis is placed on establishing accredited national trial hubs, promoting translational research, and creating “train-the-trainer” mechanisms to build local faculty capacity. By implementing these strategies, China can not only improve patient outcomes but also emerge as a global contributor to precision neuro-oncology.

Keywords: Neuro-Oncology; Medical Education; Fellowship Training; Multidisciplinary Care

1. Introduction

The burden of neuro-oncological diseases, such as glioma, metastases, and other primary brain tumors, has been steadily rising in China, with the incidence being 7.40 per 100,000 persons and the estimated new cases up to 101200 (Han et al., 2024; Ding & Wang, 2011). Each type of these tumors has its own unique characteristics in terms of growth pattern, location, and biological behavior, leading to widely varying management approaches (Louis et al., 2021). For example, in most cases of meningioma, which typically expand in a well-circumscribed manner, surgical resection alone is often sufficient (Goldbrunner et al., 2021). In contrast, glioma, accounting for a significant proportion of brain malignancies, is characterized by an infiltrative nature, heterogeneity, and adaptive resistance. Consequently, its treatment usually demands a multidisciplinary strategy integrating surgery, radiotherapy, chemotherapy, as well as emerging targeted and immunotherapies (Weller et al., 2021; Stupp et al., 2005). Neurosurgeons are often at the forefront of these treatment regimens, except for radiation therapy. Meanwhile, surgeons from other specialties mainly concentrate on surgical interventions, and oncology specialists formulate subsequent therapeutic strategies for neoplastic diseases related to their respective fields. In the era of molecular pathology, neurosurgeons ought to have a good command of neuro-oncology medical knowledge to facilitate the development of individualized treatment plans. However, the existing training models for neurosurgeons in China do not sufficiently address the complexity of comprehensive care, necessitating significant improvements to enhance patient outcomes (Wang & Zhang, 2020). Herein, we conduct a retrospective analysis of the underlying issues within oncology development in Mainland China, review the advancements in neuro-oncology training achieved in Western countries, and explore potential strategies for enhancing the current training program (Jensen et al., 2006).

2. Current State of Neuro-Oncology Education in China

Neuro-oncology is an interdisciplinary field that requires a comprehensive understanding of neurosurgery and oncology. Physicians need to master a vast amount of knowledge, including the anatomy and physiology of the nervous system, imaging diagnosis of neurological diseases, the pathological mechanisms of tumors, and various treatment methods. The knowledge is not only extensive but also highly specialized, demanding professional training and long-term learning. However, there is a prevalent shortage of specialized neuro-oncology departments in almost all hospitals in China (Wang & Zhang, 2020). The lack of an independent institutional identity is strongly associated with no standardized and adequate training curriculum for young doctors and fewer opportunities for specialized educational activities, which exacerbates the situation of the shortage of professional talent (Lu-Emerson et al., 2025). Though some top-tier hospitals in big cities like Beijing, Shanghai, and Guangzhou might have a group of doctors with a focus on neuro-oncology, the number of dedicated neuro-oncology units remains limited (Valvi et al., 2023; Liu et al., 2023).

Currently, the approach to cultivating neuro-oncologists primarily relies on neurosurgery training. The training model for neurosurgical postgraduates has increasingly become more

standardized, with a seven-year training program broken into 2 blocks having been nationally adopted (Xu et al., 2016). In the initial stage, trainees titled residents spend 3 years rotating through general surgery and its subspecialties, orthopedic surgery, anesthesiology, urology, pathology, radiology, critical care medicine, and surgical intensive care. This three-year foundational training fosters the development of generalist medical knowledge and basic surgical skills. Completion of the foundation block and passing a national standardized examination, residents can earn a certificate and become eligible for the advanced stage. Then, trainees will be promoted to attending and receive 4 years of dedicated neurosurgery training. Year 1 includes rotations in neurology, neuropathology, neurophysiology, neuro-intensive care, microsurgical neurosurgical anatomy, and microsurgical skill laboratory. In the second and third year, rotations through six subspecialties of neurosurgery are mandatory, including neurotrauma, tumor, vascular, spine, and a choice of one elective rotation in pediatrics and functional, and one from skull base surgery and neuro-intervention. Each subspecialty rotation lasts four months, and during this period, trainees are concurrently responsible for outpatient and emergency consults. Year 4 consists of a one-year period, termed the chief resident, handling the entire service. However, the seven-year training program is adaptive to cultivate neurosurgeons but not neuro-oncologists. Significant challenges faced by neuro-oncology trainees in neurosurgical training (Shi et al., 2025). Primarily, neurosurgery encompasses a wide range of highly specialized areas, and each subfield requires a deep understanding of unique pathologies and treatment modalities. Moreover, limited time is allocated for rotations in each subspecialty, resulting in insufficient depth of experience in a single area (Zhang & Li, 2025). On the other hand, the development of surgical technical skills is always traditionally prioritized in training, which sometimes overshadows other aspects of disease management. As is known, neuro-oncology is a rapidly evolving field, with frequent advancements in molecular diagnostics, targeted therapies, and immunotherapies (Aquilanti & Wen, 2023). Keeping up with these developments while simultaneously mastering other subspecialties adds another layer of difficulty for trainees (Aquilanti & Wen, 2023). More importantly, neuro-oncology is inherently multidisciplinary, requiring close collaboration with medical oncologists, radiation oncologists, pathologists, and other specialists (Pillay et al., 2016). However, neurosurgical training programs may not always provide sufficient exposure to these collaborative practices, hindering the development of the holistic approach necessary for effective neuro-oncology care (Khalafallah et al., 2021; De Swart et al., 2021).

Another pathway to becoming a neuro-oncologist involves transitioning from a background in neurology or medical oncology. This route offers a distinct perspective and skill set that complements the traditional neurosurgical training pathway, particularly in the non-surgical aspects of neuro-oncology care. Specifically, neurologists who transition into neuro-oncology bring a deep understanding of the nervous system, including its anatomy, physiology, and pathophysiology. Their expertise in diagnosing and managing neurological disorders, such as seizures, cognitive impairment, stroke, and nervous system infections, is invaluable in the care of patients with brain tumors. Neurologists are also well-versed in interpreting neuroimaging studies and managing neurological complications of cancer and its treatments, such as chemotherapy-induced neuropathy or radiation-induced cognitive decline. However, transitioning neurologists lack standardized training in oncology principles, including tumor biology, systemic therapies,

and comprehensive treatment planning based on personalized biomarkers. Medical oncologists who move into neuro-oncology bring a strong foundation in cancer biology, systemic therapies, and the management of metastatic disease. Their experience with chemotherapy, targeted therapies, and immunotherapies is critical for treating primary and metastatic brain tumors. Oncologists are also skilled in managing the side effects of cancer treatments and providing palliative care. However, they may be required to have a good level of comfort with neurology-specific topics, such as neuroanatomy, neuroimaging, and the management of neurological symptoms unique to neuro-oncological diseases. Generally, this transforming pathway is valuable but difficult, especially in conditions without appropriate fellowship training, and the number of successfully transformed neuro-oncologists remains relatively small (Hayse, 2025).

3. International Neuro-Oncology Training Models

Neuro-oncology has evolved into a distinct multidisciplinary domain that bridges neurosurgery, neurology, medical oncology, and radiation oncology (Wen et al., 2008). Training pathways worldwide reflect this complexity, requiring physicians to develop a robust understanding of both surgical and non-surgical treatments for central nervous system (CNS) tumors (Malbari et al., 2020; Di Bonaventura et al., 2025). Over the past decades, the United States (U.S.) and several European countries have led the formalization of neuro-oncology curricula, accreditation standards, and research infrastructures, providing valuable models that can inform developing programs elsewhere (Jensen et al., 2006).

3.1. United States

In the U.S., aspiring neuro-oncologists can enter the field through different primary specialties, most commonly neurosurgery, neurology, or medical oncology, before pursuing formal fellowship training (Gonzalez Castro et al., 2022). For those taking the neurosurgical route, the typical pathway begins with four years of medical school, followed by a seven-year neurosurgery residency (Ng et al., 2023; Limoges et al., 2020). During residency, trainees rotate through subspecialties such as neurotrauma, spine, vascular neurosurgery, and neuro-oncology, although the depth of exposure in each area can vary by institution. Upon completing residency, physicians may seek additional specialization through a two- to three-year fellowship accredited by bodies like the United Council for Neurologic Subspecialties (UCNS) or, more recently, certain programs recognized by the Accreditation Council for Graduate Medical Education (ACGME).

By contrast, individuals entering neuro-oncology from neurology or medical oncology complete a three- to four-year residency in their primary field, often coupled with a year of internal medicine in the case of neurology. They subsequently undertake a specialized fellowship in neuro-oncology, where they gain expertise in diagnosing and managing CNS tumors, understanding neuropathology, and employing cutting-edge therapeutic modalities, including chemotherapy, targeted agents, and immunotherapies. These fellowships frequently involve dedicated rotations in radiation oncology, neuroradiology, and neuropathology, ensuring that graduates can collaborate effectively with different specialists (Jensen et al., 2006). Many prominent cancer centers, such as MD Anderson Cancer Center, Memorial Sloan Kettering

Cancer Center, and Dana-Farber Cancer Institute, run research-intensive neuro-oncology fellowships, allowing trainees to participate in clinical trials and laboratory-based translational studies. This close integration of bench and bedside nurtures a cadre of physician-scientists capable of driving advancements in molecular diagnostics, novel therapeutics, and personalized care (Mäurer et al., 2022).

U.S. programs also emphasize board certification or equivalent credentials. The UCNS offers a specific examination in neuro-oncology, testing fellows on their knowledge of tumor biology, neuroimaging, symptom management, and therapeutic interventions. Achieving certification through UCNS or other relevant boards (e.g., American Board of Medical Specialties) is increasingly recognized as a marker of specialization, helping create consistent standards across diverse training sites.

3.2. Europe

Across Europe, there is a similarly rigorous but more regionally varied approach to neuro-oncology education (Weller et al., 2017). Medical training in many European countries consists of an integrated six-year curriculum, after which graduates enter a residency in neurosurgery, neurology, or oncology, usually lasting four to six years. Trainees aiming for a neuro-oncology focus often seek out advanced fellowships in specialized centers. These fellowships typically last one to three years and may be structured through national or supranational bodies.

European programs generally adopt a collaborative model in which trainees spend significant time working alongside medical oncologists, radiation oncologists, and palliative care teams (Kreye et al., 2022). This setup underscores the necessity of viewing CNS tumors through a holistic lens, with careful attention to neurological complications, quality of life, and functional rehabilitation. Research is also an integral component, while some centers emphasize clinical trials and protocol-based care, others encourage fellows to pursue PhD programs or postdoctoral research, often with a strong translational science focus (Kandi & Vadakedath, 2023). This dual track of clinical and academic training can prepare future consultants to navigate rapidly evolving treatment paradigms, such as targeted therapies against specific molecular alterations and immune checkpoint inhibitors.

3.3. Emerging Trends

One notable difference between U.S. and European models lies in the structure and length of clinical education. In the U.S., the undergraduate and medical school phases are distinct, followed by residency and fellowship, leading to a longer overall training period. In Europe, medical education is frequently condensed into a single six-year degree, with greater variability in how specialty training is organized afterward. However, both regions increasingly recognize the importance of standardized certification processes and share a commitment to multidisciplinary teamwork.

The focus on molecular diagnostics and personalized therapy has become a unifying theme worldwide (Louis et al., 2021). Trainees must develop familiarity with genomic profiling, biomarker-driven treatment regimens, and next-generation imaging techniques. This shift in neuro-oncology necessitates closer collaboration among neurosurgeons, neuro-oncologists,

radiologists, and pathologists, highlighting the value of structured rotations in each specialty. Formal fellowships provide an avenue for immersion in such interdisciplinary care, whether through joint tumor boards, combined clinics, or collaborative research initiatives. Moreover, technological advances, ranging from intraoperative MRI to stereotactic radiosurgery, have broadened the therapeutic landscape, driving the need for ongoing education and Continuing Medical Education (CME) programs even after formal training (Wu et al., 2022; Guru et al., 2024).

Although North America and Europe have led the establishment of formal neuro-oncology fellowships, other regions are increasingly adopting similar frameworks. In parts of Asia, for instance, large academic centers are formalizing collaborative training models with international institutions, incorporating telemedicine and online coursework to supplement clinical rotations (Shakir et al., 2024a; Shakir et al., 2024b). Such cross-border partnerships not only expand access to expert mentorship but also facilitate comparative research on genetic and environmental factors influencing tumor incidence and outcomes. These developments underscore a fundamental principle that effective neuro-oncology training demands a breadth of clinical, surgical, and scientific skills. By embracing multidisciplinary curricula, standardized accreditation, and robust research platforms, existing models in the U.S. and Europe have paved the way for emerging programs worldwide.

Compared with the well-established independent identity of neuro-oncology as a subspecialty in the U.S. and Europe, China's system remains heavily rooted in general neurosurgery. Furthermore, while Western models rely on robust external accreditation (e.g., ACGME or UCNS), China's training is primarily hospital-led. Therefore, the transition in China requires a shift from 'department-specific training' to 'interdisciplinary national standards'.

4. Developing Neuro-oncology Training in China

The training frameworks in the U.S. and Europe offer a template for nurturing specialists who can address the complexity of neuro-oncological diseases, however, the development of neuro-oncology training in China must be tailored to align with our country's healthcare landscape, resource availability, and patient needs (Xiao et al., 2023). To ensure the feasibility and sustainability of the proposed strategies, a three-phased implementation roadmap is recommended, transitioning from foundational standardization to high-level international integration. Phase 1: Standardization and Pilot Programs (Years 1-2). The immediate priority is to define national competency standards and establish pilot fellowship centers in top-tier academic hospitals. Phase 2: Expansion and Digital Integration (Years 3-5). The focus shifts to integrating interdisciplinary rotations (e.g., radiotherapy, pathology) and leveraging online platforms to bridge regional training gaps. Phase 3: Research-driven Excellence and Global Alignment (Year 5+). The long-term goal is to institutionalize "train-the-trainer" programs and align Chinese training standards with international accreditation bodies.

4.1. Establishment of Standardized Training Programs

Realistically, it is prioritized to integrate structured neuro-oncology training into existing medical education frameworks (Xu et al., 2016). National associations, such as the Chinese

neurosurgical society or specialized oncology organizations, can collaborate with government health agencies to establish regional demonstration centers dedicated to neuro-oncology and launch fellowship programs (1-2 years) appended to residencies in neurology, neurosurgery, or oncology (Wang & Zhang, 2020). Proposed curricula emphasize core competencies such as neuroanatomy, neurological tumor biology, multimodal therapies, molecular diagnostics, and palliative care, while incorporating mandatory research projects and ethics training (Frank et al., 2010). Training programs would adopt a competency-based structure, blending clinical rotations in neurosurgery, radiation oncology, and neuropathology with multidisciplinary tumor boards (Frank et al., 2010; Di Bonaventura et al., 2025). Moreover, developing uniform national standards for neuro-oncology training is crucial to ensure consistent care across China (Zhang et al., 2020). These professional societies should outline course requirements and accreditation criteria, and national guidelines can also integrate regular evaluations and on-site assessments to guarantee quality and uniformity among training centers.

4.2. Leveraging Continuous Education and Online Platforms

While structured neuro-oncology training programs are the cornerstone of professional development, continuing education and digital learning platforms serve as supplements to formal education, ensuring clinicians remain updated on evolving standards, technologies, and therapeutic strategies, or offering flexibility to practitioners navigating geographical constraints and time limitations (Sherman et al., 2024). Continued education focuses on specialized, topic-driven learning through webinars or seminars addressing cutting-edge advancements and case-based multidisciplinary discussions. These targeted programs, often organized by professional associations, enable clinicians to rapidly update skills in niche areas (Berg et al., 2025). Online platforms prioritize systematic, structured curricula, offering longitudinal learning pathways and comprehensive courses (e.g., certified modular programs) that cover foundational to advanced neuro-oncology competencies, such as tumor biology, multimodal treatment protocols, or palliative care ethics (Wang et al., 2021; Su et al., 2021; Wang et al., 2025). By integrating continuous education and online learning platforms with standardized neuro-oncology training programs, the neuro-oncology community can sustain expertise, bridge regional disparities, and accelerate the integration of research into practice, ultimately elevating patient care across all tiers of the healthcare system (Kim et al., 2025; Ge et al., 2024).

4.3. Enhancing Training Via Global Collaborations

Establishing certification standards aligned with globally recognized frameworks will facilitate cross-border collaborations, and partnerships with leading institutions worldwide offer valuable opportunities. Collaborative initiatives, such as joint fellowship programs with globally renowned centers, can expose trainees to cutting-edge techniques and novel therapies in brain malignancies (Shakir et al., 2024a; Shakir et al., 2024b). Structured exchange visits could include immersive observerships, where trainees engage in real-time tumor boards discussions, or hands-on training in emerging platforms (Mousavi et al., 2024). To institutionalize knowledge transfer, “train-the-trainer” programs could also pair Chinese faculty with international mentors to co-design curricula integrating global best practices with local realities (Gao et al., 2018; Gao et al., 2020). Embedding these collaborative frameworks will cultivate a self-sustaining ecosystem where

international expertise accelerates local innovation, ultimately positioning its neuro-oncology community as a global contributor in precision neuro-oncology care.

4.4. Strengthening Clinical Trials

Advancing high-quality clinical trials is essential to address gaps in evidence-based neuro-oncology care and therapeutic innovation (Xu et al., 2016). Despite a rising burden of brain tumors, participation in practice-changing trials remains limited due to fragmented infrastructure and insufficient researcher training. To address these gaps, neuro-oncology training programs should strengthen competency in clinical trial methodology, including protocol development, biostatistics, and ethical governance (Jensen et al., 2006). Trainees should engage in designing and executing investigator-initiated trials tailored to regional priorities (Yu et al., 2025). Central to this effort is establishing a national network of accredited trial hubs to standardize protocols, streamline ethics approvals, and enable multicenter collaborations. Additionally, integrating translational endpoints into trials will bridge preclinical and clinical research, and robust quality control through multiple mechanisms will enhance trial credibility (Zhao et al., 2021; Louis et al., 2021).

5. Conclusion

Neuro-oncology stands at the intersection of rapidly advancing molecular science and highly specialized techniques, making it a pivotal focus area in modern healthcare. In China, the growing incidence of neuro-oncological diseases highlights the urgency of developing robust, standardized training pathways that span neurosurgery, neurology, and oncology. Despite existing challenges, such as resource disparities, limited multidisciplinary exposure, and evolving therapeutic approaches, there are clear opportunities for progress. Strengthening national standards, leveraging platforms and international collaborations, and enhancing research participation can all contribute to bridging current gaps. By embracing these strategies, China has the potential to not only improve patient outcomes but also shape the global landscape of neuro-oncology through innovative research and clinical excellence.

6. Limitations and Future Directions

This study is primarily a qualitative review of existing frameworks. A key limitation is the lack of quantitative data regarding the current competency levels of early-career neurosurgeons across different Chinese provinces. Future research should employ nationwide surveys or longitudinal studies to evaluate the effectiveness of pilot fellowship programs and the impact of online learning on closing the urban-rural gap in neuro-oncological care.

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References

- Aquilanti, E., & Wen, P. Y. (2023). Advanced molecular diagnostic tools: A step closer to precision medicine in neuro-oncology. *Neuro-Oncology*, 25, 1750.
- Berg, F., Andujar, A., Chatman, G., Rodríguez-Galindo, C., Qaddoumi, I., & Moreira, D. C. (2025). Online outcomes of a pediatric neuro-oncology course for multidisciplinary healthcare professionals in low- and middle-income countries. *Journal of Cancer Education*. Advance online publication. <https://doi.org/10.1007/s13187-025-02681-4>
- De Swart, M. E., Kouwenhoven, M. C. M., Hellingman, T., Kuiper, B. I., Gorter de Vries, C., Leembruggen-Vellinga, M., et al. (2021). A multidisciplinary neuro-oncological triage panel reduces the time to referral and treatment for patients with a brain tumor. *Neuro-Oncology Practice*, 8, 559.
- Di Bonaventura, R., Aiudi, D., Chiesa, S., Pellerino, A., Bruno, F., Internò, V., et al. (2025). Education paths in neuro-oncology: Combining technical skills with multidisciplinary care. A survey from the AINO (Italian Association for Neuro-Oncology) Youngster Committee. *Journal of Neuro-Oncology*, 173, 469–477.
- Ding, L. X., & Wang, Y. X. (2011). Increasing incidence of brain and nervous tumours in urban Shanghai, China, 1983–2007. *Asian Pacific Journal of Cancer Prevention*, 12, 3319–3322.
- Frank, J. R., Snell, L. S., Ten Cate, O., Holmboe, E. S., Carraccio, C., Swing, S. R., et al. (2010). Competency-based medical education: Theory to practice. *Medical Teacher*, 32, 638–645.
- Gao, P., Guan, L., Liu, Y., Liu, F., Yu, W., Li, X., et al. (2020). Cultivating global health professionals: Evaluation of a training course to develop international consulting service competence in China. *Global Health Journal*, 4, 51–56.
- Gao, P., Xiang, H., Liu, S., Liu, Y., Dong, S., Liu, F., et al. (2018). Evaluation of a consulting training course for international development assistance for health. *BMC Medical Education*, 18, 234.

- Ge, J. J., Li, C., Xue, F.-J., Qi, S.-P., Zhao, C., Kong, C.-C., et al. (2024). EPID-38. Global disparities and projections in pediatric brain and CNS cancers: A comprehensive analysis through 2050. *Neuro-Oncology*, 26, 146.
- Goldbrunner, R., Stavrinou, P., Jenkinson, M. D., Sahm, F., Mawrin, C., Weber, D. C., et al. (2021). EANO guideline on the diagnosis and management of meningiomas. *Neuro-Oncology*, 23, 1821–1834.
- Gonzalez Castro, L. N., Forst, D. A., Plotkin, S. R., & Lee, E. Q. (2022). A practical guide to neuro-oncology fellowship. *Journal of Neuro-Oncology*, 156, 73–79.
- Guru, S., Lam, F. C., Akhavan-Sigari, A., Hori, Y. S., AbuReesh, D., Tayag, A., et al. (2024). “Beyond the knife”—Applying theranostic technologies to enhance outcomes in neurosurgical oncology. *Brain Sciences*, 14, 1253.
- Han, B., Zheng, R., Zeng, H., Wang, S., Sun, K., Chen, R., et al. (2024). Cancer incidence and mortality in China, 2022. *Journal of the National Cancer Center*, 4, 47–53.
- Hayse, L. (2025). Evaluation of adult neuro-oncology fellowship webpages, including associated GME sites (P4-5.002). *Neurology*, 104, 3674.
- Jensen, R., O’Rourke, D., Warnick, R., & Sawaya, R. (2006). Resident training in neurosurgical oncology: Results of the survey of North American training programs by the AANS/CNS Section on Tumors. *Journal of Neuro-Oncology*, 77, 241–246.
- Kandi, V., & Vadakedath, S. (2023). Clinical trials and clinical research: A comprehensive review. *Cureus*, 15, e35077.
- Khalafallah, A. M., Jimenez, A. E., Romo, C. G., Kamson, D. O., Kleinberg, L., Weingart, J., et al. (2021). Quantifying the utility of a multidisciplinary neuro-oncology tumor board. *Journal of Neurosurgery*, 135, 87–92.
- Kim, Y., Armstrong, T. S., Gilbert, M. R., & Celiku, O. (2025). Disparities in the availability of and access to neuro-oncology trial-supporting infrastructure in the United States. *JNCI: Journal of the National Cancer Institute*, 117, 511–516.
- Kreye, G., Lundebj, T., Latino, N., Galotti, M., & Kaasa, S. (2022). ESMO designated centres of integrated oncology and palliative care (ESMO DCs): Education, research and programme development survey. *ESMO Open*, 7, 100622.
- Limoges, N., D’Agostino, E., Gelinne, A., Maher, C. O., Scott, R. M., Grant, G., et al. (2020). Pediatric neurosurgery training during residency in the United States: A program director survey. *Journal of Neurosurgery: Pediatrics*, 26, 6–12.
- Liu, A. P. Y., Sun, C., & Qaddoumi, I. (2023). Landscape of pediatric neuro-oncology care in China. *Pediatric Medicine*, 6, 22–45.
- Louis, D. N., Perry, A., Wesseling, P., Brat, D. J., Cree, I. A., Figarella-Branger, D., et al. (2021). The 2021 WHO classification of tumors of the central nervous system: A summary. *Neuro-Oncology*, 23, 1231–1251.
- Lu-Emerson, C., Chowdhary, S., Kotecha, R., Sharma, A., Odia, Y., Vaillant, B., et al. (2025). A pilot survey into the landscape of neuro-oncology care in the community. *The Oncologist*, 30, 47.
- Malbari, F., Partap, S., Gust, J., Duke, E., Sato, A., Khakoo, Y., et al. (2020). Neuro-oncology training for the child neurology resident. *Journal of Child Neurology*, 36, 79–86.

- Mäurer, M. A., Mäurer, I., & Kamp, M. A. (2022). Can neuro-oncology teaching contribute to educate medical doctors better? A reflection on the value of neuro-oncology for student teaching. *Chinese Neurosurgical Journal*, 8, 23.
- Mousavi, S. E., Seyedmirzaei, H., Shahrokhi Nejad, S., & Nejadghaderi, S. A. (2024). Epidemiology and socioeconomic correlates of brain and central nervous system cancers in Asia in 2020 and their projection to 2040. *Scientific Reports*, 14, 1–16.
- Ng, P. R., Yearley, A. G., Eatz, T. A., Ajmera, S., West, T., Razak, S. S., et al. (2023). Neurological surgery residency programs in the United States: A national cross-sectional survey. *Neurosurgery*, 94. <https://doi.org/10.1227/NEU.0000000000002703>
- Pillay, B., Wootten, A. C., Crowe, H., Corcoran, N., Tran, B., Bowden, P., et al. (2016). The impact of multidisciplinary team meetings on patient assessment, management and outcomes in oncology settings: A systematic review of the literature. *Cancer Treatment Reviews*, 42, 56–72.
- Shakir, M., Khowaja, A. H., Shariq, S. F., Irshad, H. A., Tahir, I., Rae, A. I., et al. (2024a). Workforce challenges for the neurosurgical care of brain tumors in low- and middle-income countries: A scoping review. *World Neurosurgery*, 189, 387–398.
- Shakir, M., Shariq, S. F., Irshad, H. A., Khowaja, A. H., Tahir, I., Rae, A. I., et al. (2024b). Barriers to neurosurgical care of brain tumors in low- and middle-income countries: A systematic review of the service delivery challenges. *World Neurosurgery*, 187, 211–222.
- Sherman, L., Kuang, M., Yang, D. Y. D., & Chappell, K. (2024). An overview of continuing medical education/continuing professional development systems in China: A mixed methods assessment. *Journal of CME*, 13, 2363855.
- Stupp, R., Mason, W. P., van den Bent, M. J., Weller, M., Fisher, B., Taphoorn, M. J. B., et al. (2005). Radiotherapy plus concomitant and adjuvant temozolomide for glioblastoma. *The New England Journal of Medicine*, 352, 987–996.
- Su, B., Zhang, T., Yan, L., Huang, C., Cheng, X., Cai, C., et al. (2021). Online medical teaching in China during the COVID-19 pandemic: Tools, modalities, and challenges. *Frontiers in Public Health*, 9, 797694.
- Valvi, S., Dun, M. D., & Hansford, J. R. (2023). National brain tumour registry: A new era of research collaboration with China. *The Lancet Regional Health-Western Pacific*, 34, 100739.
- Wang, J., & Zhang, Y. (2020). Training neurosurgeons in China. *The Lancet Neurology*, 19, 971–972.
- Wang, P., Wu, Z., Zhang, J., He, Y., Jiang, M., Zheng, J., et al. (2025). Distance learning during the COVID-19 lockdown and self-assessed competency development among radiology residents in China: Cross-sectional survey. *JMIR Medical Education*, 11, e54228.
- Wang, Z. Y., Zhang, L. J., Liu, Y. H., Jiang, W. X., Jia, J. Y., Tang, S. L., et al. (2021). The effectiveness of e-learning in continuing medical education for tuberculosis health workers: A quasi-experiment from China. *Infectious Diseases of Poverty*, 10, 1–11.
- Weller, M., van den Bent, M., Preusser, M., Le Rhun, E., Tonn, J. C., Minniti, G., et al. (2021). EANO guidelines on the diagnosis and treatment of diffuse gliomas of adulthood. *Nature Reviews Clinical Oncology*, 18, 170–186.

- Weller, M., van den Bent, M., Tonn, J. C., Stupp, R., Preusser, M., Cohen-Jonathan-Moyal, E., et al. (2017). European Association for Neuro-Oncology (EANO) guideline on the diagnosis and treatment of adult astrocytic and oligodendroglial gliomas. *The Lancet Oncology*, 18, 315–329.
- Wen, P. Y., & Kesari, S. (2008). Malignant gliomas in adults. *The New England Journal of Medicine*, 359, 492–507.
- Wu, A., Wu, J. Y., & Lim, M. (2022). Updates in intraoperative strategies for enhancing intra-axial brain tumor control. *Neuro-Oncology*, 24(Suppl 7), S33–S41.
- Xiao, D., Yan, C., Li, D., Xi, T., Liu, X., Zhu, D., et al. (2023). National Brain Tumour Registry of China (NBTRC) statistical report of primary brain tumours diagnosed in China in years 2019-2020. *The Lancet Regional Health-Western Pacific*, 34, 100715.
- Xu, T., Evins, A. I., Lin, N., Chang, J., Hu, G., Hou, L., et al. (2016). Neurosurgical postgraduate training in China: Moving toward a national training standard. *World Neurosurgery*, 96, 410–416.
- Yu, X., Chen, Y., & Podolsky, S. H. (2025). The history of controlled clinical trials in China. Part 2: From the advent of large-scale multicentre randomised controlled trials through contemporary self-reflection. *Journal of the Royal Society of Medicine*. Advance online publication. <https://doi.org/10.1177/01410768251347259>
- Zhang, L., Jia, W., Ji, N., Li, D., & Xiao, D. (2020). Establishment of the national brain tumor registry of China. *Journal of Global Oncology*, 2020, 47–48.
- Zhang, Y. W., & Li, A. W. (2025). Understanding Chinese early-career neurosurgeons' professional identity construction as clinician-researchers. *World Neurosurgery*, 195, 123645.
- Zhao, Z., Zhang, K. N., Wang, Q., Li, G., Zeng, F., Zhang, Y., et al. (2021). Chinese glioma genome atlas (CGGA): A comprehensive resource with functional genomic data from Chinese glioma patients. *Genomics, Proteomics & Bioinformatics*, 19, 1–12.

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