



Education for Perioperative Neuroscience Excellence

# PROGRAM REQUIREMENTS FOR ADVANCED TRAINING IN PERIOPERATIVE NEUROSCIENCE

## NEUROANESTHESIOLOGY

Version 33

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## INTRODUCTION

Residency and fellowship programs are essential dimensions of the transformation of the medical student to an independent practitioner. As postgraduate learners, they begin the life-long continuum of medical education, a physically, emotionally, and intellectually demanding process.

The specialty education of physicians to practice independently is largely experiential, and necessarily occurs within the context of the health care delivery system. For the fellow, the essential learning activity is interaction with patients under the guidance and supervision of faculty members who give value, context, and meaning to those interactions. Fellows ultimately exercise independent skills based on their capability to synthesize knowledge and experience in a given patient context. This concept - graded and progressive responsibility - is one of the core tenets of graduate medical education. Supervision in the setting of graduate medical education assures patients safe and effective care. This supervision also assures that the fellow expands their skills, knowledge, and attitudes as required to independently practice neuroanesthesia and all related fields.

Neuroanesthesia fellows prepare to become outstanding clinicians, educators, and researchers. Fellowship instills the commitment to lifelong professional growth and development of in-depth knowledge in a specific area of anesthesiology beyond that acquired in residency. Specialty trained physicians become leaders in their respective clinical and academic fields. ICPNT promotes all facets of perioperative neuroscience training. The ICPNT program requirements outline the neuroanesthesiology and neuroscience standards for program accreditation for fellowship training.

## **I. DEFINITION AND SCOPE**

### **a. Definition of Neuroanesthesiology**

Neuroanesthesiology is the subspecialty of anesthesiology devoted to the comprehensive anesthetic and perioperative management of patients undergoing surgical and radiologic procedures on the central and peripheral nervous systems where neural tissue is at risk.

Neuroanesthesiologists should be involved in the overall care of patients who are undergoing any surgical procedure that places any component of the nervous system at risk; this includes neurosurgery, neuroradiology, structural spine, critical care and all other medical or surgical conditions that require neuroscience expertise. The neuroanesthesiologist executes an anesthetic plan that incorporates patient co-existing medical conditions and surgical management needs to optimally support neurologic outcome.

The neuroanesthesiologist is an expert in neuroscience and has a unique knowledge of neuropharmacology, action of anesthetic and adjunct drugs used for neurosurgery and other surgical procedures. This area delves into mechanisms of anesthetic actions, potential neuroprotective and neurotoxic effects of anesthetics, interactions of anesthetic and non-anesthetic drugs with the pathophysiology of neurosurgical problems as affected by the procedural intervention and other intra-procedure physiologic aberrations.

Neuroanesthesiology is not just focused on intraoperative issues. Indeed, reforms in health care worldwide are supporting increasing involvement of anesthesiologists in the perioperative continuum. Neuroanesthesiologists are expected to be involved in activities that will include perioperative and neurocritical care assessment and management of complex neurologic disease.

Neuroanesthesiology also involves an understanding of issues in perioperative neuromonitoring. Given that the anesthetic paradigm used for a given patient can significantly impact the data obtained from intraoperative neuromonitoring, this is an important and essential body of knowledge unique to neuroanesthesiology. As such there is overlap with the growing discipline of perioperative neuromonitoring.

### **b. Duration and Scope of Training**

Fellows must spend a minimum of 80% of their fellowship engaged in guided and supervised perioperative neuroscience activities to include clinical care and scholarly activity. Fellows ultimately exercise independent skills based on their capability to synthesize knowledge and experience in a given patient context. Activities are approved by the Program Director and in agreement with ICPNT recommendations. Clinical training should be completed within a maximum of 24 months from beginning the program. The clinical training time may be discontinuous and interspersed with academic time devoted to research, other nonclinical academic pursuits or medical practice outside the fellowship (e.g., independent practice of anesthesia or other medical specialties).

## **II. ORGANIZATION REQUIREMENTS**

### **a. Programs**

#### **i. Sponsoring Organization**

A single sponsoring organization, Anesthesiology Department, Hospital or Medical School, must assume ultimate responsibility for the program, and this responsibility extends to guaranteeing all fellowship requirements at all participating sites are met. The sponsoring organization's Letter of Agreement (LOA) must be provided to the ICPNT and should contain the following:

1. An organizational leadership contact.
2. A designated fellowship leader (program director) must be identified.
3. The sponsoring institution and the fellowship program must ensure that the program has sufficient financial, administrative and academic resources to meet program requirements. This should include the customary support to the program director to meet the responsibilities

- outlined in the program requirements outlined by the ICPNT (III.A.S).
4. A statement of assurance that the Fellowship Program Director and the sponsoring institution will maintain a Sponsoring Letter of Agreement (SLOA) for all participating programs as outlined in requirements and assure compliance with program requirements.
  5. It is recommended but not required that the Sponsoring Institution sponsor or be associated with a regionally accredited anesthesiology or other postgraduate clinical (residency) program.
  6. An updated version of the Sponsoring Letter of Agreement (SLOA) must be submitted to the ICPNT within 30 days of a change in any of the elements identified above in this section.

## **ii. Participating Sites**

There must be a Clinical Site Letter of Agreement (CSLOA) or equivalent between the program and each participating clinical site providing a required experience. The CSLOA must be renewed by the sponsoring institution at least every five years. The CSLOA should:

1. Identify the faculty who will assume both educational and supervisory responsibilities for fellows.
2. Specify the faculty's responsibilities for teaching, supervision, and formal evaluation of fellows (See III a-d).
3. Specify the duration and content of the educational experience.
4. State the policies and procedures that will govern fellow education during the assignment at each participating site.
5. Identify the institutional official who oversees the fellowship program director at the participating site.
6. Submit an updated Clinical Site Letter of Agreement (CSLOA) to the ICPNT within 30 days of a change in any of the elements identified above (II, A, 2.).

## **b. Setting**

The setting for a neuroanesthesiology educational program must encompass a clinical location which includes operating suites, post anesthesia care area, interventional radiology suite, surgical critical care/therapy unit devoted entirely to neurological critical care or a blended surgical neurological care/therapy unit, and perioperative neuromonitoring facilities. This education may take place in various settings that provide for the care of critically and neurologically ill surgical patients, including those with traumatic injuries, cerebrovascular insults, neuro-oncologic/infectious disorders, status epilepticus, neuromuscular, and spine and spinal cord disorders.

## **c. Educational Sites**

An adequate volume and diversity of clinical experience must be available in the sponsoring and affiliate health care organizations. All facilities providing clinical training must be appropriately accredited and/or licensed by the regional, national or international regulatory organization(s) responsible for hospital accreditation within the local region (i.e., Japan Medical Services Accreditation for International Patients (JMIP), Healthcare Organizations Accreditation Programme, France). The accrediting organization must be regionally recognized. The facilities are licensed inpatient hospitals and are in good standing with their accreditation organization and local public health regulatory associations.

Sites must cumulatively provide sufficient experienced personnel, adequate procedural diversity and volume to meet ICPNT recommendations. (Appendix 2, 3, 4). The sponsoring and affiliated institutions must have interventional radiology facilities sufficient to fulfill the fellowship experience requirements. The sponsoring institution or affiliated programs must have a Neurologic/Neurosurgical Intensive Care Unit or have beds devoted to neurological and neurosurgical conditions and patients in a mixed-use ICU.

Educational experiences must meet the local sponsoring institution standards and are required to provide the ICPNT recommended educational experience. Programs may use modular rotations (continuous fixed time period) or longitudinal training (experience when clinical material is available) but the end result must meet the ICPNT educational guidelines (Appendix 3). Clinical experience obtained during elective specialty interest rotations apply to the minimum time required in mandatory rotations when appropriate. Participating

program rotations must have their facilities and their faculty submitted with the application as part of the accreditation process (a.-f.). Unique or single event educational modules at internal or external organizations do not need a CSLOA but should be documented in the yearly report to the ICNPT with a description of the rotation period. The clinical rotation facility must be locally accredited.

Verification of participation with a description of expectations and documentation of successful completion of the educational experience is necessary for all educational activities (Appendices 2, 3).

### **III. PROGRAM PERSONNEL AND RESPONSIBILITIES**

#### **a. Program Director**

##### **i. Program Director Qualifications:**

1. Current medical licensure and appropriate institutional medical staff appointment as appropriate for the geographical locale of the fellowship program (e.g., Canada FRCPC, UK FRCA).
2. Current certification in anesthesiology as regionally required or possess other acceptable qualifications or experience that allows the practice of anesthesiology. The individual should be an active member of the anesthesiology faculty and must devote a significant part of their practice to neuroanesthesiology.
3. Current certification or formal education in neuroanesthesia or neurocritical care is desirable. In lieu of specialized training, regionally or internationally recognized, or extensive experience and expertise is needed.
4. Requisite clinical expertise and documented educational and administrative experience is necessary. Optimally the individual should have a minimum of five years' experience in clinical and academic neuroanesthesiology. Established academic productivity is desirable.
5. Academic achievements may include following:
  - a. Publications in peer reviewed journals.
  - b. The development of national, regional or local educational curriculum.
  - c. Engagement in quality development activities.
  - d. Significant involvement in neuroanesthesia educational efforts for anesthesiology residents.
  - e. Invitations to deliver regional, national, or international lectures and seminars relevant to neuroanesthesiology, or;
  - f. Recognized research in the fields of clinical anesthesiology and basic science research. A program director must have continuing significant time devoted to clinical neuroanesthesia practice.
6. Facility to communicate in English is an expected attribute of the program director.
7. Active membership the Society for Neuroscience in Anesthesiology and Critical Care (SNACC) is required for the program director as a means to foster the necessary communications between and among program directors and ICPNT, which is administratively in SNACC.

##### **ii. Program Director Responsibilities:**

The program director must administer and maintain an educational environment conducive to educating the fellows in each of the delineated competency areas. The program director shall:

1. Prepare and submit all information required and requested by the ICPNT.
2. Be familiar with and oversee compliance with ICPNT policies and procedures.
3. Maintain communication with ICPNT:
  - a. Complete the ICPNT formal initial application including materials requested to

- maintain and support program accreditation.
      - b. Communicate significant program changes (e.g., change in personnel or leadership, educational site, fellow activity) within 30 days.
      - c. Assure faculty and fellow participation in ICPNT activities designed to improve and expand neuroanesthesiology education.
- 4. Administrative requirements include but are not limited to:
  - a. New program application for ICPNT accreditation.
  - b. Continuing program requirement documentation.
  - c. Provide appropriate clinical supervision/guidance to the fellows.
  - d. Develop and enforce a supervision policy of the fellow that meets the definitions endorsed by the ICPNT and meet regional standards. Specific ICPNT recommendations are found at VIIa. The policy must specify fellow's oversight responsibility for the anesthesiology residents or other direct providers.
  - e. Maintain a written outline of the educational program goals to include didactic knowledge, technical skills, clinical performance and professionalism expected during each module, academic activity or other program assignment that include ICPNT expectations (Appendix 2, 3).
  - f. Regularly organize teaching and academic activities for the fellows such as journal clubs, case conferences, morbidity and mortality meetings, continuous quality improvement activities, didactic conferences, webinars, internet based educational opportunities, and research conferences. Participation in these activities should be an educational expectation with documentation of attendance suggested.
  - g. Support adherence to the Code of Ethics and Professional Conduct of the World Health Organization (APRIL 2017) relating to non-discrimination in selection of fellows as allowed by local custom.  
[http://www.who.int/about/ethics/code\\_of\\_ethics\\_full\\_version.pdf](http://www.who.int/about/ethics/code_of_ethics_full_version.pdf)
- 5. Evaluation of program, fellows and faculty:
  - a. Implement a formal fellow evaluation process in compliance with local requirements. Assess for satisfactory accomplishment of educational, clinical and technical goals and objectives. It is recommended that periodic feedback through evaluation (formative) be provided to the fellow, faculty, module leadership and affiliated institutions.
  - b. A summative evaluation with the fellow at the end of the training is encouraged but not required. Anonymous notification to the ICPNT regarding the final status of all fellows is required yearly.
  - c. Provide a formal avenue for appeal of an adverse action that meets local standards.
- 6. Participate in the sponsoring institutional process for recruitment of fellows and faculty.
- 7. Report major change in the program structure outlined in original application, including:
  - a. Adverse local program citations, responses and mitigation of adverse actions regarding the educational programs involving fellow activities.
  - b. Requests for appeal of an adverse action by the ICPNT regarding the fellowship program.
  - c. Voluntary withdrawal from the ICPNT-accredited program.
  - d. Update faculty annually with ICPNT.
- 8. Certify and document fellowship outcome to ICPNT
  - a. Inform ICPNT of fellowship outcome for each uniquely identified enrolled fellow: successful, unsuccessful, or incomplete/withdrawn.

- i. A start and anticipated completion date for each fellow must be submitted to the ICPNT within 30 days enrollment.
  - ii. A fellow's status is determined solely by the sponsoring organization. Consequently, all inquiries except to verify the sponsoring organization accreditation status will be redirected to the sponsor program.
  - iii. The ICPNT may receive uniquely identified fellow transcripts and other documents. For educational research a waiver or release will be provided to the program to allow participation.
- b. Maintain up to date records of all fellowship activities. Maintain a transcript of successful fellowship rotations including the number and type of clinical experiences as suggested by the ICPNT (Appendix 2, 3). Submit to the ICPNT within 30 days of the fellowship completion on the ICPNT provided documents.
- c. Report to ICPNT any unsuccessful completion, program withdrawal or termination of fellowship within 30 days.
- d. Upon successful completion of the fellowship, the sponsoring organization must provide to the graduating fellow an institutional certificate documenting completion of the fellowship. As allowed by institutional protocols, the certificate should indicate the accrediting program is the International Council on Perioperative Neuroscience Training (ICPNT), a component of Society for Neuroscience in Anesthesiology and Critical Care (SNACC).

## **b. Core Faculty**

- i. The program director must appoint core faculty and they must be included in the fellowship program accreditation application. A neuroanesthesiology fellowship training program should have dedicated faculty for mentoring, training, providing feedback, and evaluating performance of the trainees.
- ii. There must be at least two core faculty members (including the program director) with documented qualifications to instruct and supervise fellows. Core clinical faculty must be active in the clinical practice of anesthesiology, neuroanesthesiology or critical care.
- iii. The neuroanesthesiology core faculty should have the following qualifications:
  - 1. The core physician faculty should demonstrate a strong interest in the education of neuroanesthesiology fellows. They will be expected to teach, supervise, and provide formal feedback and evaluations of fellows to ICPNT standard.
  - 2. The core physician faculty must possess current medical licensure, institutional medical staff appointment, and a current certification in anesthesiology as appropriate for the local requirements.
  - 3. The core physician faculty must have as regionally required or possess other acceptable qualifications or experience in neuroanesthesiology, neurocritical care, and neurointerventional radiology.
  - 4. The core physician faculty, in leu of fellowship training, should have a minimum of three years of post-residency experience in respective.
  - 5. The core physician faculty should be encouraged to be academically productive in a fashion relevant to neuroanesthesiology (with at least one of the following: publications, educational development, formal quality improvement programing, or clinical/basic research (Appendix 4).
  - 6. It is recommended that the core faculty be members in good standing of a professional neuroscience-oriented organization or interest group.

## **c. Ancillary Faculty**

- i. The program director must appoint ancillary anesthesia trained faculty who may practice at the primary organization or affiliated organizations (i.e., another hospital), and they must be included in

- the fellowship program accreditation application. The ancillary faculty must devote sufficient time to the educational program to meet the supervisory and teaching responsibilities requested by the program director.
- ii. Ancillary faculty must be willing to supervise, organize, educate and develop a fellowship rotation as requested by the program director. In that capacity they will be expected to teach, supervise, and provide formal feedback and evaluations of fellows to ICPNT standards.
  - iii. Ancillary faculty must be willing to participate in the didactic educational program.
  - iv. This faculty should participate in fellow selection process at the request of the program director.

**d. Adjunct Faculty**

- i. The program director must appoint adjunct faculty and they must be included in the fellowship program accreditation application. Adjunct faculty will be faculty from other subspecialty training programs (such as neurological intensive care, neurosurgery, neurology, pain management, interventional neuroradiology, neuroscientist) that provide clinical, research or academic experiences valued in the fellowship program.
- ii. Neuroscientist faculty who do not fulfill qualifications for core clinical faculty may possess significant experience in clinical or basic neuroscience and should be designated as adjunct faculty. They can supervise one or more fellowship rotations in their area of expertise at the request of the program director.

**e. Non-physician Program Personnel**

Perioperative neuromonitoring technicians, transcranial doppler sonographers, and research staff, advanced practice medical professionals may contribute to the training of the neuroanesthesiology fellows without formal title or submission of qualifications to the ICPNT.

**f. Administrative Personnel**

A well-functioning program requires administrative support in the form of sufficient appropriately equipped and supplied personnel to enable performance of support functions such as scheduling, organizing educational events, and reporting activities and educational statistics to ICPNT.

## **IV. RESOURCES**

- a. There must be access to neurocritical care service with specialized nursing for neurocritical care which may be a component of a mixed-use intensive care (or therapy) unit. There must be access to dedicated neuroradiological clinical services capable of providing educational experience interpreting and where applicable performing Computerized Tomography (CT) scan, Magnetic Resonance Imaging (MRI), neuroangiography, and interventional neuroradiology procedures.
- b. There must be access to dedicated neuroradiological services capable of performing CT scan, MRI, neuroangiography, and other interventional neuroradiology procedures. In addition, there must be access to specialized training in neuroradiology.
- c. Education in Intraoperative Neuromonitoring (IONM) services is required and clinical experience is recommended. At the discretion of the program director, exposure to IONM services when not locally available can be pursued using ICPNT and SNACC referrals.
- d. There must be suitable access to consultation with other disciplines, including cardiology, critical care medicine, emergency medicine, neurology, pulmonology, laboratory medicine and surgical fields. There must be allied health staff, other support personnel and facilities to provide ICPNT suggested standards of care. This care must also be applicable to the regional medical community.

- e. **Medical Information Access**  
Fellows, faculty, and staff must have ready access to specialty specific and other appropriate reference material in print or electronic format. Internet-based medical literature databases with search capabilities and institutional access to research publications should be available.

## **V. FELLOW APPOINTMENTS**

### **a. Eligibility Criteria**

#### **i. Each Fellow Must:**

1. Be eligible for a medical license (independent, training, or institutional) as required by law and applicable to the institution(s) participating in the fellowship program.
2. Have successfully completed an accredited (as customarily defined in the relevant region) anesthesiology residency, or;
3. For an enrolled (during residency) fellowship, be a resident in good standing in an accredited residency program (as customarily defined in the relevant region) and have completed a minimum of two years of clinical anesthesiology residency.

#### **ii. Each Program Must:**

1. Document that each fellow has met the eligibility criteria.
2. Advocate adherence to the Code of Ethics and Professional Conduct of the World Health Organization relating to non-discrimination in selection of fellows while adhering to the local institutional requirements. [http://www.who.int/about/ethics/code\\_of\\_ethics\\_full\\_version.pdf](http://www.who.int/about/ethics/code_of_ethics_full_version.pdf)

### **b. Number of Fellows**

The program's educational resources must be adequate to support the number of fellows appointed to the program. The number of fellows cannot exceed the number of core faculty. The presence of other learners or staff members must not interfere with the appointed fellows' education.

A fellowship program without enrolled fellows can be accredited.

## **VI. Educational Program**

### **a. Competencies:**

Fellows must spend at least 80% of their fellowship in supervised then guided neuroscience activities to include required and elective clinical care and scholarly work as designated by the program director.

The ICPNT recommends the following competencies are integrated into the local didactic and clinical curriculum. The details of the requirements are outlined in Appendix 2, 3.

#### **i. Patient Care and Procedural Skills**

Fellows must be able to provide safe, effective, evidence-based patient care that is compassionate and appropriate. Under the direction of faculty members fellows must demonstrate:

1. The ability to provide clinical consultation for neurosurgical and neuroradiology patients, including assessment of the appropriateness of a patient's preparation for anesthesia care during surgery or interventional neuroradiology.
2. The ability to provide clinical consultation for non-neurosurgical patients with neurological diseases, regarding assessment of the appropriateness of a patient's preparation, preoperative clinical management and neuromonitoring. Knowledge to recommend IONM studies during

interventional radiology, cardiac, vascular surgery and peripheral procedures involving neurologic tissue e.g., brachial plexus schwannoma or neurofibrosarcoma is required.

3. Competence in intraoperative patient management and perioperative care of patients with neurologic disease during neurosurgery, intracranial, spine and spinal cord and interventional neuroradiology is required.
4. The ability to independently execute technical procedures, manage the invasive device and interpret the information provided during patient care procedures is necessary. The extent of required competency should reflect local medical practices.
5. Competence in the comprehensive anesthetic management of patients undergoing neurosurgical, structural spine and neuroradiology procedures is available in Appendix 2 and Appendix 3. This must include:
  - a. Preoperative assessment, optimization and risk stratification. Obtaining then interpreting appropriate diagnostic tests and specialty medical consultations.
  - b. Effective communication with the multi-disciplinary teams.
  - c. Anesthetic drug selection and administration.
  - d. Appropriate positioning.
  - e. Post anesthesia recovery and neurocritical care management.
  - f. Detection and management of venous air embolism, hemorrhage and other complications.
  - g. Monitoring and management of patients with brain edema, intracranial hypertension, cerebral ischemia, and epilepsy.
  - h. Anesthesia care for awake craniotomy with cortical mapping, awake placement of Deep Brain Stimulators (DBS) for movement disorders, seizure foci ablation.
  - i. Provision of anesthetic care for surgical procedures in MRI and CT locations.
  - j. Perioperative pain management.

#### **ii. Medical Knowledge**

Fellows must demonstrate knowledge of established and evolving relevant neuroscience (e.g., biomedical, clinical, and social-behavioral science), as well as synthesize and apply this knowledge to patient care. Fellows must demonstrate competent application of their knowledge, with specific emphasis on the anesthetic implications of the altered central and peripheral nervous system.

#### **iii. Professionalism**

Fellows are expected to have mastered professionalism during residency training skills and habits related to professionalism. However, they should participate and demonstrate leadership in required professionalism activities that are a component of the residency or hospital-based programs.

### **b. Didactic Component**

- i. The didactic curriculum should be provided through journal clubs, lectures, case conferences, morbidity and mortality meetings, research conferences, facilitated self-learning, and workshops, and should supplement clinical experience all of which should include participation and/or leadership of a fellow.
- ii. Faculty members should lead the majority of the sessions. Conferences may be supplemented by attendance at external meetings, webinars, or other methods of internet-based education.
- iii. The didactic curriculum should include all topics previously listed as expected medical knowledge competencies.

### **c. Clinical Components**

Curriculum elements will be addressed in a clinical or practice setting. The curriculum must have a goal to incorporate principles and knowledge in neuropathophysiological, neuropharmacological, and general medicine in order to provide high level care to patients undergoing neurosurgical, structural spine, and neurointerventional procedures. The clinical curriculum should be structured to acquire necessary knowledge and experience. Educational structure should be adapted to optimize educational opportunity in the local environment.

Specific suggestions for competencies acquired in each module can be found in Appendix 2, 3.

**d. Scholarly Activities**

This area addresses the curriculum elements that will be related through scholarly activities and included:

- i. Each fellow is encouraged to conduct or be substantially involved in a scholarly project which leads to presentations, preferably by the fellow, at a national or regional meeting, and/or publication. At a minimum each fellow should deliver local presentations related to their interests or research.
- ii. The fellow must have a faculty mentor overseeing the project and any presentations or publications.

**e. Educational Program Resources and Facilities**

- i. The institution and the program must jointly ensure the availability of adequate resources for fellow education.
- ii. The patient population must include medically complex patients undergoing high- and low-risk surgical procedures in sufficient volume and variety to provide a broad clinical and educational experience for each fellow.
- iii. There must be an active critical care service that is regularly involved in multidisciplinary care including neurocritical care.
- iv. An active intraoperative neuromonitoring service that is regularly involved in perioperative multidisciplinary care is recommended but not required. This service must be overseen by a neuroanesthesiologist, neurologist, PhD-level neurophysiologists or neurosurgeon with appropriate qualifications, certification, and experience may also oversee this program. An external rotation with duration specified by the program director may be arranged if this service is not available.
- v. There must be facilities and space for the education of fellows, including meeting space, conference space, space for academic activities, and access to computers and medical records. Interactive electronic communication (i.e., "Zoom") should be provided.
- vi. Fellows, faculty, and staff must have ready access to specialty-specific and other appropriate reference material in print or electronic format. Internet-based medical literature databases with search capabilities and institutional access to research publications should be available.

## **VII. Program Assessment and Quality Activities**

**a. Supervision of Fellows**

To assure high quality patient care, and fellow education, there must be explicit expectations regarding the transition from supervision to guidance. These are specifically outlined in Appendix 3.

- i. In the clinical learning environment, each patient must have an identifiable, appropriately credentialed and privileged attending physician who is trained to local level of expected expertise (licensed independent practitioner as approved by each institution). They are ultimately responsible for patient care. This would be the supervising faculty but could be the fellow who has successfully completed training and required local credentialing.
- ii. Application of Supervision Policy  
The privilege of progressive authority and responsibility, conditional independence, and a supervisory role in patient care delegated to each fellow must be assigned by the program director and faculty members and be consistent with local regulations.

The suggested progression of clinical independence will depend on the assessment of the program director, the faculty and compliance with the progression of responsibility defined in the accredited sponsoring organization.

**Levels of Supervision:** To ensure oversight of fellow supervision and graded authority and responsibility, the program must use the following classification of supervision by clinical faculty:

1. Direct Supervision - The supervising physician is physically present with the fellow and patient.
  2. Indirect Supervision - Direct supervision immediately available when requested. Customary supervision requires a designated supervising physician for all clinical activity that are considered to contribute to the fellowship experience. The supervision attributes should be determined by the program and outlined for the ICPNT.
    - a. The supervising physician is physically within the hospital or another site of patient care and is immediately available to provide direct supervision and/or consultation.
    - b. The supervising physician is not necessarily physically present within the hospital or other site of patient care but is immediately available by means of telephone and/or electronic modalities and is available to provide consultation and/or direct supervision.
    - c. Depending on institutional rules indirect supervision may entail the fellow having an appointment as an instructor or junior faculty. Fellows can be allowed to function as junior faculty, as allowed by institutional guidelines and local laws and regulations, and will still be indirectly supervised or guided by core faculty consultants. Advancement to this level of independence requires that the fellow demonstrates satisfactory improvement during the training program.
  3. Oversight - The supervising physician is available to provide review of procedures/encounters with feedback provided when immediate consultation and advice is requested or after care is delivered.
- iii. The program director must evaluate each fellow's abilities based on achievement of competencies described in this document.
  - iv. Faculty members functioning as supervising physicians should delegate portions of care to fellows, based on the needs of the patient and the skills of the fellows.
  - v. Fellows should serve in a supervisory role of residents or junior fellows in recognition of their progress toward independence, based on the needs of each patient and the skills of the individual fellow. Fellow supervision of residents must be in agreement with the program director of the residency program.
  - vi. For indirect and direct supervision, the plan for each anesthetic should be discussed with the supervising faculty. Programs must set guidelines for circumstances and events in which indirectly supervised fellows must communicate with appropriate supervising faculty members, such as the transfer of a patient to an intensive care unit, changes in anesthetic plan or patient condition, or end-of-life decisions.
  - vii. Each fellow must know the limits of their scope of authority and the circumstances under which they are permitted to act with conditional independence.
  - viii. Faculty supervision assignments should be of sufficient duration to assess the knowledge and skills of each fellow and delegate to them the appropriate level of patient care authority and responsibility.
  - ix. Trainees undergoing an enrolled fellowship in which they are not yet fully trained anesthesiologists must be supervised as residents according to guidelines of the institutional residency program for a given level of prior residency experience.

## **b. Clinical Responsibilities**

The clinical responsibilities for each fellow must be based on post medical school years of training, years of anesthesiology training and experience, patient safety, fellow education, severity and complexity of patient illness/condition and available support services.

### **i. Teamwork**

Fellows must care for patients in an environment that maximizes effective communication. This must include the opportunity to work as a member of effective inter-professional teams that are appropriate to the delivery of care in the specialty

### **ii. Fellow Duty Hours**

1. Hours per week and per shift should be dictated by local custom. It is important to recognize undo fatigue negatively affects learning and performance.
2. In unusual circumstances, fellows, on their own initiative, may remain beyond their scheduled period of duty to continue to provide care.
3. Moonlighting defined as unsupervised practice should not be counted towards the training and must not interfere with the ability of the fellow to achieve the goals and objectives of the educational program. However, rules on local custom dictate program decisions.

## **c. Evaluation**

### **i. Fellow Evaluation**

1. Formative Evaluation for education purposes
  - a. The faculty must evaluate fellow performance in a timely manner. The ICPNT expectation is the method of evaluation will be dictated by local custom. The following information is considered best practice and is strongly encouraged.
  - b. The faculty should provide evaluations of each fellow's progress and competency to the program director after each rotation and when requested by the program director.
  - c. The program should:
    - i. Provide objective assessments of competence in patient care and medical knowledge according to the academic guidelines of the institution.
    - ii. Use multiple evaluators (e.g., faculty, peers, patients, self, and other professional staff); and,
    - iii. Provide each fellow with documented evaluation of performance with feedback at least semiannually.
    - iv. Provide each fellow with feedback evaluation at the end of each rotation.
2. The evaluations of fellow performance must be accessible for review by the fellow in accordance with institutional policy and ICPNT recommendation.
3. Disciplinary and remedial actions:
  - a. Fellows who violate local rules and expectations regarding behavior or professionalism should be subject to disciplinary actions in accordance with local institutional policy.
  - b. Fellows who are progressing poorly in terms of achieving competency goals of the fellowship may, at the discretion of the program director, be subject to remedial action which may include slowing the rate of increasing responsibility, repeating rotations, increasing duration of the fellowship, attending additional conferences or lectures, participating in simulation activities, or other constructive endeavors.
  - c. The primary consideration for any educational program is the future patients who will be under the care of the trainee. Based on this, there should thus be no reluctance to discharge a poorly performing trainee who is deemed to be unlikely to

achieve the goals of the fellowship.

4. **Summative Evaluation**

The program director must provide a summative evaluation for each fellow upon completion of the program. This evaluation may include a summary of monthly evaluations or an oral and/or written examination consistent with institutional academic guidelines and must become part of the fellow's record as maintained by the institution and should be accessible for review by and discussed with the fellow in accordance with institutional policy. This evaluation must:

- a. Document the fellow's performance during the final period of education, and;
- b. Verify that the fellow has demonstrated sufficient competence to enter advanced and independent neuroanesthesiology practice after completion of required anesthesiology training.
- c. Summarize the case experience (based on ICPNT definition of case credits) of each fellow during their fellowship.

**ii. Faculty Evaluation**

1. At least annually, the program must incorporate faculty performance evaluation as it relates to the educational program.
2. These evaluations should include a review of the faculty's clinical teaching abilities, commitment to the educational program, clinical knowledge, professionalism, and scholarly activities.
3. Steps should be taken to assure anonymity of the evaluations as dictated and available in local customs.

**iii. Program Evaluation**

1. The program director must document formal, systematic evaluation of the curriculum at least annually. The program must monitor and track each of the following areas:
  - a. Fellow performance
  - b. Faculty development
2. Both faculty and fellows should have the opportunity to provide anonymous feedback regarding all aspects of the program. This should include program director, core, adjunct and ancillary faculty as well as each rotation and each institution. Assessment by the residents is required.
3. Residents should be directed to the appropriate local authority to perform the evaluation. Timely evaluation, within 15 days of the event is strongly recommended.
4. If local deficiencies are found, the program should prepare a written plan of action to document initiatives to improve performance. This will be submitted by the program director and the Organization leadership to the ICPNT. The action plan for remediation should be reviewed and approved by the teaching faculty and documented in meeting minutes.

**d. Program Quality Improvement**

Quality improvement is a standard requirement for faculty. It improves organizational and most importantly patient outcomes. All neuroanesthesia faculty, fellow(s), ancillary staff and residents should organize and execute a yearly quality project and monitor the impact the activity had within the organization. A brief report on these activities will be expected yearly or at the program review.

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## **Appendix 1. Description of Terms**

### **Accreditation**

The process of validating the fellowship program by the ICPNT, a peer review organization, based on a standardized evaluation process utilizing ICPNT established criteria for conducting a standardized training experience and knowledge competencies.

### **Accredited**

A program that is officially recognized as meeting the essential requirements of clinical and academic excellence by the accrediting organization.

### **Competency**

An element of expertise indicating that a fellow has sufficient familiarity with a topic, concept, or procedure to be able to safely perform or deliver that specific competency in the course of being a neuroanesthesiologist.

### **Core Faculty**

Individuals identified by the program director who meet the neuroanesthesiology qualification criteria outlined by ICPNT. These individuals have a prominent role in training and evaluating the candidates within a program.

### **Fellow**

An individual who is a trainee in a fellowship program. In this capacity the fellow, who otherwise can conduct an anesthetic independently, participates in an essential learning activity. Their interaction with patients is under the guidance and supervision of faculty members who give value, context, and meaning to those interactions. Fellows ultimately exercise independent skills. This concept - graded and progressive responsibility - is one of the core tenets of graduate medical education. This judgment is delegated to the program director by the sponsoring organization. In situations of an enfolded (in-residency) fellowship, wherein the fellow will not have been fully trained and locally licensed in anesthesiology, the degree of supervision and independence will be consistent with the fellow's level of experience and local custom. It will be determined by the sponsoring organization's customary performance assessment process.

### **Fellowship**

A post-graduate subspecialty training experience acquired during or after specialty training in anesthesiology. Fellows must spend a minimum of 80% of their fellowship engaged in supervised perioperative neuroscience activities to include clinical care and scholarly activity. Activities are approved by the Program Director and in agreement with ICPNT recommendations. Clinical training should be completed within a maximum of 24 months from beginning the program. The clinical training time may be discontinuous and interspersed with academic time devoted to research, other nonclinical academic pursuits or medical practice outside the fellowship (e.g., independent practice of anesthesia or other medical specialties).

### **Fully Trained (Qualified) Anesthesiologist**

A physician who has successfully completed a post medical school training experience in anesthesiology and is eligible for certification/licensing as an independently practicing physician in their local community.

### **Program Director**

The person in the core faculty who has a subspecialty leadership position and the recognized responsibility for ensuring ICPNT curriculum-defined competencies are available within the accredited program and that the fellow has participated in these activities before graduating.

### **Residency**

A post medical school specialty training program. In anesthesiology, the residency duration, clinical competencies, and knowledge assessment will be as mandated by the region or country where it is performed.

### **Subspecialty Training Program**

An educational program within a clinical environment comprising of teaching faculty with appropriate staff support and facilities, which altogether delivers a specified curriculum to educate subspecialists within a defined time period.

### **Synthetic Knowledge in Neuroanesthesiology**

"Requires experience or observation" - It is knowledge gained by combining and integrating a diverse combination of clinical and basic neurosciences knowledge relevant to neuroanesthesiology. Truth is knowable by both knowing the meaning of the words and something about the world.

## Appendix 2. Clinical and Cognitive Competencies

Fellows must be able to provide safe, effective, evidence-based patient care that is compassionate and appropriate. Upon completion of the fellowship each candidate must have demonstrated independent competent performance in the following areas.

### I. Perioperative Anesthesia Clinical Care

#### a. Assessment

- i. Assess, optimize, risk stratify then recommend preprocedure evaluation and management for patients requiring neurosurgical, spine and neuroradiology interventions.
- ii. This includes focused neurologic examination and interpretation of required studies (e.g., magnetic resonance image (MRI), computerized tomography scan (CT), endovascular).
- iii. Perform airway intracranial pressure management (ICP), cardiovascular, pharmacologic management to optimize neurologic outcome.
- iv. Assess the need for standard physiologic monitoring and specialized procedures used for other surgical procedures.  
(e.g., arterial catheter, central venous catheter, pulmonary artery catheter, ultrasound examination, transesophageal echocardiogram.)
- v. Assess, place, interpret and develop a treatment plan using invasive and noninvasive neurophysiologic monitors.  
(e.g., ICP monitoring, endoventricular (EVD), or lumbar drain, right atrial catheter, precordial doppler, cerebral perfusion pressure monitor (epidural and intrathecal), transcranial doppler (TCD).)

#### b. Intraoperative Management Unique to Neuroanesthesia

- i. Apply principles of neuropharmacology and resuscitation as required.
- ii. Interpret invasive and non-invasive diagnostic studies and execute appropriate medical interventions in neurologically impaired or intact patients.
- iii. Apply principle of cerebral and spinal perfusion and pressure goals appropriately in response to underlying neuropathology during neurosurgical or other surgical procedures.
- iv. Manage intracranial hypertension and cerebral edema using physiologic, pharmacologic, and positioning techniques.
- v. Neurophysiologic monitoring (IONM or IOM):
  1. Be aware of anesthetic considerations in surgical procedures and choose anesthetic techniques that facilitate monitoring in the anesthetized and awake patient (cortical mapping: motor, sensory, speech).
  2. Understand the neurologic pathway that is being monitored by the specific IONM technique planned. Be able to identify and respond appropriately to differential causes, technical, pharmacologic, physiologic (e.g., hypotension, anemia) and surgical of signal degradation.
  3. Anticipate and treat neuromonitoring complications associated with patient physiology, surgical procedure and anesthetic management.
  4. Techniques include but are not limited to: auditory brainstem monitoring (auditory brainstem response (ABR), or brainstem auditory evoked potentials (BAER)), electroencephalogram (EEG-processed or diagnostic), electromyography (EMG), motor evoked potential (MEP), somatosensory evoked potential (SEP or SSEP), sensory nerve action potential (SNAP) and compound motor action potential (CMAP)

and direct cortical or spinal cord mapping.

- vi. Demonstrate anesthesia management proficiency based on surgical situation for deep brain stimulation (DBS) procedures, awake and anesthetized, multiorgan trauma, all vascular (e.g., aneurysm, arteriovenous malformation, cerebrovascular disease) and tumor procedures (intracranial, spinal, peripheral vascular).
- vii. Recognize and competently manage unique surgical, physiological, and clinical risks associated with supratentorial, posterior fossa, base of skull (e.g., transsphenoidal pituitary, craniopharyngiomas, vestibulocochlear therapies), spinal cord, spine, and peripheral nerve surgical procedures and specific disorders like seizures pathology.
- viii. Management proficiency includes selection and use of monitors, fluid and cardiovascular management, drug selection, appropriate positioning to prevent injury and postoperative follow up long term outcome.
- ix. Management proficiency in positioning including supine, prone, sitting, lateral for a neurosurgical and spine procedures.
- x. Recognize interference on hemodynamic on IONM monitors.
- xi. Adapt neuroanesthesia management in all surgical situations as requested.

**c. Spine Intraoperative Management**

Spine intraoperative management encompasses both structural spine and spinal cord procedures that are a combination of instrumentation in cervical, thoracic and lumbar spine, as well as spine and spinal cord pathologies (tumors, trauma, idiopathic and degenerative scoliosis, spinal stenosis and other degenerative or inflammatory disease). Additional areas of expertise include:

- i. Positioning-prone, supine, lateral
- ii. Blood loss-hemodynamic instability
- iii. Coagulopathy
- iv. Cardiovascular management
- v. Chronic pain management
- vi. Minimally invasive procedures
- vii. Neurologic injury, intraoperative neuromonitoring (IONM)
- viii. Postoperative visual loss

**d. Postoperative Management**

Provide transfer of care based on expertise in both postanesthesia skills and neurocritical care management principles.

**e. Clinical Procedures**

Upon completion of the fellowship each candidate must have demonstrated independent competency in interpretation and/or placement of the appropriate procedures based on availability in local practice:

- i. Interpretation and consultation of intraoperative neuromonitoring: electroencephalogram (EEG), processed EEG, electrocorticogram, evoked potentials and electromyogram (EMG).
- ii. Placement and interpretation of precordial doppler, transcranial doppler, scalp blocks.
- iii. Knowledge and understanding of brain oxygen partial pressure, cerebral blood flow monitors, cerebral oximetry, jugular bulb oxygen saturation, cerebral microdialysis.

**II. Neurocritical Care Module**

**a. Intensive Care Unit Clinical Management**

- i. Evaluate and manage critical neurological illnesses, including traumatic brain and spine injury, intracranial hypertension and herniation, ischemic or hemorrhagic stroke, status epilepticus, and brain protection after cardiopulmonary resuscitation. Appreciate the emergent need for neurosurgical or endovascular intervention and be involved in physiologic optimization of patients.
- ii. Manage spinal and ventriculostomy drains, as well as intracranial pressure (ICP) monitors.
- iii. Evaluate and treat perioperative morbidities in neurological injury patients, including central nervous system infections, cerebral vasospasm, cardiorespiratory complications of neurologic injury, electrolyte and endocrine abnormalities, and other systemic infections.
- iv. Safely transport and monitor critically ill neurological patients.
- v. Evaluate and manage postoperative pain and implement analgesic regimens tailored to the limitations imposed by the patient's neurological status.

### **III. Interventional or Endovascular Neuroradiology**

#### **a. Anesthesia Management**

- i. Understand and provide appropriate anesthetic care for various interventional neuroradiology procedures available in the sponsoring program. For example: endovascular procedures to treat aneurysm, arteriovenous malformation (AVM), thrombotic or embolic vascular occlusion for vascular or tumor, stent or other treatment for vascular dissection, venous or arterial clot removal/lysis, spinal vascular procedures, vertebroplasty
- ii. Timely management of emergency procedures, such as for acute ischemic stroke.
- iii. Appropriately manage anticoagulation and the drug reversal.
- iv. Develop perioperative and anesthetic management strategies to prevent procedure-related complications and minimize their effects if they occur.

#### **b. Endovascular Procedure Module**

Under direct supervision of the neurointerventionalist:

- i. Assess MRI and apply knowledge to the interventional procedure to be performed.
- ii. Discuss the procedure with risks and benefits with the patient or the designated medical power of attorney.
- iii. Assist the neurointerventionalist as directed which may include participation to observation.
- iv. Understand the decisions and outcomes from the intervention.
- v. Follow and assist in management of postoperative care.
- vi. Be able to identify and begin care intervention for common intravascular postoperative complications (e.g., vasospasm, vascular rebleed, neurologic exam suggesting progression of injury).

### **IV. Cognitive Module Content—Knowledge**

During the clinical modules, mastery of the following advanced neuroscience concepts should occur:

#### **a. Neuroanatomy, Neurophysiology, Neuropathology**

- i. All components of the brain, spinal cord, spine, and major peripheral nerves.
- ii. Intracranial and spinal cord blood supply and blood flow regulation and hemodynamic goals in relation to the intracranial or spinal pathology.
- iii. Effects of intramural pressure, biochemical environment, and metabolic rate on perfusion.
- iv. Principles of electroencephalography (EEG) and processed EEG, neural pathways involved in the generation of auditory, sensory and motor evoked potentials.

## **b. Neuropharmacology**

- i. Neuro- and systemic pharmacology of anesthetics, antiepileptic drugs.
- ii. Pharmacology of fluids, sodium regulation, diuretics, and osmotherapeutic agents on the central nervous system.
- iii. Interactions between neuropathology and pharmacology of anesthetics and vasoactive drugs.
- iv. Neuroprotection and neurotoxicity and relevant pharmacology.

## **c. Neurological Injury Classification and Grading**

- i. Grading scales for coma, stroke, subarachnoid hemorrhage, intraparenchymal hemorrhage, arteriovenous malformation and neurologic outcome.
- ii. Classification and treatment modalities of neurologic or spine tumors
- iii. Radiological differentiation of mass effect, subdural vs. epidural hematoma, hemorrhagic versus ischemic stroke.
- iv. Classification and pathophysiology of epilepsy.

## **d. Applied Medical Knowledge**

- i. Physiology, perioperative management of pituitary tumors.
- ii. Physiology of disorders treated with minimally invasive techniques: movement disorders, obsessive compulsive disorder (OCD), and seizure events including perioperative concerns regarding surgical interventions.
- iii. Spinal cord disorders include management of cervical spine disease- unstable, immobile and stenosis, Chiari Malformation; thoracic kyphosis, scoliosis, lumbar idiopathic and degenerative disease, and meningocele management.
- iv. Physiologic management of massive transfusion and hypoperfusion injury in spine procedures.
  - v. Management of intracranial pressure monitoring and cerebral metabolic demands.
  - vi. Mechanical ventilation modes and its implications for patients with neurological diseases.
  - vii. Diagnosis and management of sodium and osmotic derangements.

## **e. System Learning, Business Management, and Ethics (Optional)**

- i. Legal and ethical issues related to severe neurologic illness including surrogate permission, brain death, organ donation, definition and implementation of goals of care.
- ii. Principles of research in neurologically impaired patients.
- iii. Processes involved in designing and implementing clinical trials for neurological diseases.
- iv. Sound business practices and the direct and indirect costs of different neuroanesthesia analgesic and anesthetic techniques, including room allocation, staffing, and patient throughput.
- v. Organization and management of a neuroanesthesiology service, including healthcare delivery models, funding, building a service, and regional regulatory agencies with jurisdiction.

## **V. Organized Educational Activities**

### **a. Didactic Conferences:**

- i. Must be held on regular basis.
- ii. Have defined cognitive and knowledge goals.
- iii. Have a required or expected audience.

iv. Expect all participants to present appropriate material.

**b. Quality Assurance Conferences:**

- i. Required.
- ii. Expectation format used will reflect local custom.

**c. Skills/Simulation Conferences:**

- i. Have a defined technical or cognitive skill program.
- ii. Provide individual experience with the device or skill planned.
- iii. Evaluate the effectiveness of the activity.
- iv. Examples: transcranial doppler, EEG placement and interpretation, assemble and use of endoventricular device.

**d. Outside Conferences:** Participation in surgical, neuroradiology, neurocritical care educational activity is encouraged by the ICPNT.

**e. Research:** The topics and participation in activities developed by sponsoring program.

**VI. Educational Methods**

**a. Problem-Based Learning Discussion (PBLD)**

**b. Daily or Weekly Clinical Case Presentations**

**c. Informal Case Presentation of Daily Clinical Activity to Residents**

**d. Self-learning Conferences**

**e. Formal Lectures**

**f. Formal Journal Club**

## Appendix 3. Curriculum Modules

The one-year fellowship consists of cognitive and clinical experience-based modules that are managed by the Sponsoring Organization. It is recognized that the experience components will depend on clinical opportunities. It is recommended that, when possible, the program provide linked cognitive and clinical experiences over a discretely defined time period (rotation). However, the availability of clinical opportunities will determine the structure of the Sponsoring Organization's training experience. It is recommended that knowledge, didactic education be organized in specific modules while the acquisition of clinical experience occurs over time until the program director determines that competence is achieved.

Fellows must provide safe, effective, evidence-based patient care that is compassionate and appropriate. The local curriculum should be designed to provide the opportunity for the fellow to become, upon completion, an independent competent neuroanesthesiologist. The fellow must be cognitively and technically competent, in all areas of patient care that requires the special expertise of the neuroanesthesiologist: pre-anesthetic evaluation, intraoperative management and postoperative care of patients undergoing neurosurgical, interventional neuroradiology procedures, spine and ideally Intraoperative Neuromonitoring (IONM, IOM). A compendium of suggested knowledge, clinical care, and anesthetic experience is in Appendices 2 and 4.

The fellow should also demonstrate neurocritical care skill within the scope of training provided. A fellow should be competent to provide consultation, specialized recommendation or services for neurologically complex patients undergoing non-neurosurgical procedures.

Case numbers are required to document direct fellow involvement in accordance with ICPNT definitions. Each fellow will be de identified to the ICPNT. All performance assessments will remain with the Sponsoring Program. Using this ID, case experience logs will be reported to ICPNT. Similarly, a report that certifies the fellows' outcome will be provided to the ICPNT within 30 days of a status change (III.a.ii.5.c). The ICPNT should not receive information that would allow the fellow to be identified. All fellowship decisions are determined by the sponsoring program and the program director. Annual reports which are provided by ICPNT are needed for program renewal.

### I. Training Modules and Fellow Experiences

#### Fellow Clinical Supervision Guidelines

- a. **Levels of Supervision:** To ensure oversight of fellow supervision and graded authority and responsibility, the program must use the following classification of supervision by clinical faculty:
  - i. Direct Supervision - The supervising physician is physically present with the fellow and patient.
  - ii. Indirect Supervision - With direct supervision immediately available.
    1. The supervising physician is physically within the hospital or another site of patient care and is immediately available to provide direct supervision and/or consultation.
    2. The supervising physician is not necessarily physically present within the hospital or other site of patient care but is immediately available by means of telephonic and/or electronic modalities and is available to provide consultation and/or direct supervision.
  - iii. Depending on institutional rules, indirect supervision and oversight may entail the fellow having an appointment as an instructor or junior faculty. Fellows will function as junior faculty in the manner expected by the institutional guidelines and local laws and regulations. Fellow activities be indirectly supervised by core faculty consultants when performing cases deemed within the practice parameters of neuroanesthesia. Fellow independence may advance to full faculty responsibilities as they

demonstrate satisfactory improvement during the training program. This decision is made by the program director with advice from the core faculty.

**iv. Oversight** - The supervising physician is available to provide review of procedures/encounters with feedback provided after care is delivered.

- b.** As fellows develop expertise in the care of neurosurgical, neuroradiological and structural spine patients, they will progress from being directly supervised to indirect supervision, oversight and finally independence. Fellows will develop supervisory skills for the continuum of trainees: residents and/or advanced practice non-physician individuals as is customary in local practice. Patient care requirements and cognitive goals for management of diseases and surgical anesthesia in the neurological system are provided in Appendix 2.
- c.** The fellow's clinical experience as well as the training progression to independent care will be reported in the Fellow Clinical Experience portion of the application. Submission is required within 30 days of fellowship completion. ICPNT Accreditation does not require a current fellow. Consequently, all sponsoring organizations will report the Available Clinical Experience (Appendix 4) as part of the ICPNT application submission. Updates as requested by the ICPNT are necessary to maintain accreditation.

## **II. Required Clinical Modules**

### **a. Adult Neurosurgical Anesthesiology Module** (minimum 24-week equivalent)

Craniotomy and spine surgery should include experience with complex surgical procedures. It is anticipated that many procedures will be available as outlined in Appendix 4. In addition to experience in standard procedures on the central nervous system, spinal cord, and spine, it is desirable but not required that fellows gain experience in anesthetic management of traumatic brain injury, surgery for movement disorders, endoscopic neurosurgery, and sitting position craniotomy. Efforts should be made to group specific procedures to maximize the depth of knowledge and clinical experience.

The ICPNT recommended minimum experience needed to acquire expertise is 50 craniotomy procedures (supratentorial, infratentorial) and 30 spine surgeries. The distribution of procedures must meet these minimum number recommendations:

- i. Five** awake craniotomies for speech, motor, and sensory mapping, may include up to two DBS surgery.
- ii. Five** craniotomies for seizure focus mapping, grid placement or seizure focus excision.
- iii. Ten** craniotomy or endovascular procedures for intracranial vascular lesions, including intracranial aneurysms, arteriovenous malformations, stroke revascularization (stroke alert).
- iv. Ten** craniotomies for tumor.
- v. Five** emergency or trauma intracranial or spine procedures
- vi. Five** spinal cord procedures for tumor or vascular treatments.

- vii. Twenty-five** structural spine surgeries that include experience with cervical and thoracic spine instrumentation.
- viii.** Five intracranial spinal fluid shunt procedures.
- ix.** Observation and interaction with a neurologist or certified IONM professional who provides monitoring for structural spine, brain mapping, vascular procedures.

When these goals cannot be met, a written explanation with the ICPNT is required.

Meeting the suggested experience in all categories not required for accreditation. However, when these targets cannot be achieved, communication with the ICPNT is needed. Accreditation requires that the ICPN fellows who successfully complete their program are able to competently manage patients presenting for procedures such as those in this list.

Appendix 4 is a tool to evaluate the breadth of clinical experience available for both the program and the ICPNT. Yearly submission of the fellows' clinical experience and the clinical material available is required.

#### **b. Neuroradiology Module (Longitudinal activity, 4-week equivalent)**

Formal and informal education regarding interpretation of Magnetic Resonance Imaging (MRI), functional MRI (fMRI) and Computed Tomography (CT) scans is necessary to be able to evaluate patient condition and anesthetic risk. The number and structure of this rotation is determined by the resources available. Experience in the interventional radiology suite participating with the faculty is also valuable. This activity will be reported in to the ICPNT as part of the fellow Activity Report.

Suggested components of this rotation could include:

Fellows develop competence in diagnostic as well as interventional or endovascular neuroradiology in the context of neuroanesthesiology. During this rotation, fellows should be exposed to neuroimaging modalities that are commonly employed in the care of neurologic patients. When available, fellows experience should include participation in the interventional neuroradiology team in order to develop an in-depth knowledge of therapeutic radiologic procedures. The fellows need to be able to perform a basic interpretation of brain, spinal cord and spine imaging and understand the technical aspects of interventional neuroradiology.

Fellows must be able to appropriately manage anesthesia for neuroradiological procedures, including therapy for stroke, carotid stenosis, cerebral aneurysm, vasospasm, and AVM. It is recognized that expertise acquired will vary according to clinical opportunity at the institution. The fundamental requirements for this rotation are in Appendix 2. The breadth of experience is evaluated in Appendix 4 and the annual clinical experience report.

The neuroradiology anesthesia module may be merged with the adult neurosurgical anesthesiology module, thereby increasing the merged module to achieve 24-week time equivalent.

#### **c. Neurocritical Care Module (4-week equivalent)**

During this rotation fellows will manage critically ill patients, with a focus on neurological or neurosurgical problems, for preoperative evaluation and preparation, and the postoperative care of neurosurgical patients. The fellows will participate in clinical and teaching rounds, and actively manage the care of these patients. This management should include invasive lines, airway management, monitoring of ICP and cerebral perfusion pressure, and understanding the role of multimodal intracranial monitoring (even if not locally employed).

Fellows will actively manage issues arising from the underlying neurologic condition, such as intracranial hypertension, cerebral vasospasm, and the systemic complications of brain injury (including cardiorespiratory, electrolyte, coagulation, and endocrine problems), as well as other common ICU problems

including sepsis, systemic shock, and multiple organ failure and learning the interactions of these pathologies on the central and peripheral nervous system.

Patient care requirements and cognitive goals for this rotation are provided in Appendix 2. Responsibilities expected or performed are evaluated in Appendix 4 and Fellow Clinical Experience portion of the application.

**d. Intraoperative Neuromonitoring Module (IONM) (Longitudinal, 4-week equivalent)**

While working under the direction of a faculty, the fellows develop the ability to understand the indications and applications of neuromonitoring modalities for complex intracranial surgery, spine surgery, and carotid endarterectomy, cardiac and aorta procedures. During this rotation the fellow should learn from the appropriate professional both the interpretation and technical aspects of obtaining IONM signal. This provides the knowledge basis to evaluate the neuromonitoring data and the interactions with anesthesia management from drug selection, cardiovascular control to appropriate positioning. Intraoperative neuromonitoring is used to guide surgical procedures and potentially avoid surgical complications. The specially trained neuroanesthesiologist may be responsible for anesthesia management and/or monitoring, interpreting the electroencephalogram (EEG) and evoked potentials, while a neuromonitoring technician performs the recording. A remote or in operating room neurologist or neurophysiologist may direct the technician and interpret the finding. Intraoperative EEG monitoring or electrocorticography can be performed to identify and excise epileptogenic foci in the brain or for other cortical function mapping. Intraoperative EEG is also performed during neurovascular surgeries including, but not limited to carotid endarterectomy or application of temporary artery clipping during aneurysm or arteriovenous malformation surgery, when EEG pattern changes are monitored to confirm adequacy of intracranial blood flow. Other neuromonitoring modalities include ICP monitoring, transcranial Doppler sonography, cerebral oximetry and PbO<sub>2</sub>, and processed EEG techniques.

The fundamental knowledge and experience requirements for this rotation are in Appendix 2.

**e. Clinical Neuroscience Scholarship Module (Longitudinal, significant experience distributed throughout the fellowship, 4-week equivalent)**

This module requires mentoring of the fellow by an attending faculty with experience in scholarly projects in the field of neuroscience. The mentor need not be a neuroanesthesiologist and the level of support and advice will depend on the fellow's experience. It is expected that the fellow will gain experience in oral presentation skills and submit written work for publication as appropriate. This module should likely be planned and initiated early in the year, so that the fellow has adequate time to pursue the academic project. It is expected that substantial basic or translational neuroscience projects would require a second year of fellowship/postdoctoral training. It is desirable that the fellows present their scholarly projects at the annual meeting of SNACC or other regional or international scientific meetings or interest groups with neuroscientific focus or component. This module may require a completed project for successful completion.

This module can involve:

- i.** Designing and conducting a clinical investigation or quality improvement initiative related to neuroanesthesiology, neurocritical care, or a related discipline.
- ii.** Preparation of a review article, book chapter, case report/series, or a database project.
- iii.** Preparation and presentation of lecture(s), journal clubs, or seminar(s) with concurrent provision of improvements in local educational resources (e.g. bibliography review, teaching materials, videos, podcasts, webpages, simulation scenarios, etc.) relevant to neuroanesthesiology.

### III. Elective Neuroanesthesia modules.

These modules can be developed in the local organization and be under the direction of the program director and core faculty. The experience may be unique or additional concentration of time in a specific area. Where appropriate the experience can be applied to the required modules. An elective module requires a structured experience to be successfully completed.

Description of these rotations require the same rigor and structure as the seen in the required rotations. There are several possible electives described here and an additional list below.

#### a. *Pediatric Neuroanesthesia Module* (Recommend 4 weeks)

Fellows who desire experience in the clinical care of pediatric neurosurgical patients can be offered an elective rotation focused on pediatric neuroanesthesiology. This module would be a rotation during which the fellows will be involved in perioperative and anesthetic care of pediatric patients undergoing neurosurgical procedures including intracranial, spine, peripheral nervous system, and interventional neuroradiology. This module may be performed in a longitudinal manner. Notably, some practices include pediatric patients in a general neuroanesthesia practice and similarly such experience confers the same goals as a modular pediatric experience but also without interfering with the global educational goals of a neuroanesthesiology fellowship. With appropriate documentation and at the request of the sponsoring program, time spent in pediatric neuroanesthesia training may apply to the 24-week global clinical requirement. An independent experience in an ICPNT-sanctioned pediatric neuroanesthesiology module cannot be construed as having participated in an accredited pediatric anesthesiology fellowship unless a cooperative arrangement between pediatric and neuroanesthesiology fellowship exists.

Intracranial procedures will include all procedures similar to those applied to adults, but with more emphasis on the treatment of diseases affecting the pediatric population. Involvement of the central nervous system is frequently seen in pediatric patients with genetic and metabolic dysfunction. These patients have specific anesthetic challenges including airway issues, hydrocephalus, malignancy with massive hemorrhage, congenital anomalies of the cardiac, pulmonary and genitourinary systems, craniosynostosis, and specific limitations in the anesthetic agents that may be used. Spine cases in the pediatric population include corrective procedures with instrumentation that may involve ventilation challenges related to restrictive lung disease. Shunt placements are also an important part of pediatric neurosurgery. The fellows should also participate in the educational conferences in the pediatric anesthesia group.

This is an elective rotation. The ICPNT recommends advanced knowledge include the basic anatomic and physiologic characteristics of the central and peripheral nervous system in pediatric patients. Additional knowledge which should be considered:

- i. Pharmacologic effects of anesthetic and antiepileptic medications in pediatric patients.
- ii. Neurologic manifestations of metabolic and genetic syndromes and their implications for anesthetic management.
- iii. Indications, contraindications, and possible complications of invasive monitoring in pediatric patients.
- iv. Age- and pathology-dependent hemodynamic goals for adequate cerebral and spinal perfusion in pediatric patients.
- v. Management of increased ICP in pediatric patients.

- vi. Identification of disorders and conditions with a higher rate of uncommon but life-threatening anesthetic complications in the pediatric population such as latex allergy and malignant hyperthermia.
- vii. Issues in neonatal and pediatric anesthetic and perioperative neurotoxicity.

**b. *Extended Neuroradiology Module***

Fellows develop competence in diagnostic as well as interventional or endovascular neuroradiology in the context of neuroanesthesiology. During this rotation, fellows should be exposed to neuroimaging modalities that are commonly employed in the care of neurologic patients. The fellows may also be a part of the interventional neuroradiology team in order to develop a more in-depth knowledge of therapeutic radiologic procedures. The fellows need to be able to perform a basic interpretation of brain, spinal cord and spine imaging and understand the technical aspects of interventional neuroradiology. Fellows develop experience to appropriately manage anesthesia for neuroradiological procedures, including therapy for stroke, carotid stenosis, cerebral aneurysm, vasospasm, and AVM. It is recognized that expertise acquired will vary according to clinical opportunity and experience gained by the fellow. The fundamental requirements for this rotation are in Appendix 2. The breadth of experience is evaluated in Appendix 4 and Fellow Clinical Experience portion of the application.

The recommended minimum experience needed to acquire expertise is cumulative time in neuroradiology of 20 days and 30 elective and emergent interventional neuroradiology procedures during the fellowship. However, the level of exposure should be determined by the program director and the neuroradiologist.

The neuroradiology anesthesia module may be merged with the adult neurosurgical anesthesiology module, thereby increasing the merged module to minimum 28-week equivalent.

**c. *Intraoperative Neuromonitoring Experience (IONM)*** (recommend 4 to 12 weeks, longitudinal)

This experience should be directed by the program resources. Outside rotations are encouraged when possible. Completion may lead to additional credentials in IONM. These may allow supervision of IONM technical personnel as well acting in a consultant capacity for surgical procedures.

**d. *Additional Program Initialed Module.*** (Recommend minimum of 2-4 weeks, longitudinal)

Elective rotation should reflect the expertise, experience and interest of the fellow and the resources of the Sponsoring Organization. Fellowship is an important moment to develop and investigate what may become career changing ideas and expertise. Such Training may be integrated into required components or be free standing components. Suggestions for such programs include expertise in Neurotrauma, Movement Disorders management and many others. A description of the goals, experience and measurable outcomes should accompany the ICPNT application or the final report or fellow experience at the end of the fellowship.

Suggested rotations might include (App 2 IV.e)

- Neurotrauma
- Anesthesia for Subspecialty Structural Spine Surgery
- Extended Critical Care Experience
- Anesthesia or Participation In Subspecialty of Neurosurgical Care (e.g., Deep Brain Stimulus, Awake Craniotomy, Posterior Fossa, Endovascular Procedures)
- Additional Research, Quality Improvement, Educational Simulation Projects.