Developing a Basic / Translational Research Career Focus:
A Guide for Pediatric Neurosurgeons

Authors: Amanda M. Saratsis, MD FAANS & Brian J. Dlouhy, MD FAANS
Research Committee Co-Chairs: David Hersch, MD FAANS, Amanda Saratsis, MD FAANS

The following is a guide for pediatric neurosurgeons who are interested in developing as neurosurgeon-scientists in this field. Working as a neurosurgeon-scientist is a challenging yet rewarding career, and can be done with success to truly make an impact on clinical outcomes for our patients. There are multiple resources available to gain support in building an academic research career, and multiple opportunities to develop a research program and connect with the research community at large. It is our hope that the following guide provides a framework through which trainees and junior faculty can better understand the pathway to research independence. Please feel free to contact the authors and / or members of the Research Committee with questions or comments.

I. Becoming a Neurosurgeon-Scientist

a. Background Training and Experience

You can become a neurosurgeon scientist. All you need is the will and the drive, and a particular question you are burning to answer with your research. Although many would argue that it is far easier to become successful as a neurosurgeon-scientist if you have had a significant amount of research experience during undergrad, medical school or residency, it is not absolutely necessary. You can find many examples of successful neurosurgeon scientists without much prior research experience or publications before their faculty job. Many did not do a PhD. Mentorship is key in developing the skills and knowledge necessary to carry forward into a scientific career. Integrating your clinical practice with your research endeavors makes good sense and increases your likelihood of success.

b. Identifying an area of Research

Ideally you will have identified an area of academic interest or particular research question during medical school and / or residency that you wish to pursue into your career. It is important during residency to become involved in research, no matter what your background is, in order to gain skills and demonstrate a commitment to the career path. Finding surgeon-scientist mentors during residency (see section below) is also highly valuable in order to gain a better sense of what is possible and what resources or projects may be available for you at your institution. In order to explore your options, attend seminars and lectures at your institution when possible. This will give you a better sense of what faculty are pursuing and possible areas of interest for you.

Once you've identified the area of interest / research question you wish to pursue, it is important to develop your project and research questions in a way that you can distinguish yourself from the work of your mentor, in order to carry your science with you into your first faculty position. Although many research questions remain, it is important

that the question you are asking and the problem you are trying to solve, is of utmost importance. Obtaining extramural grant support is dependent on your research question(s) and hypotheses being significant and incredibly meaningful.

II. Establishing a Lab

a. Negotiating Startup Funding and Budgeting

Startup lab budget for an early career investigator will vary significantly by institution and neurosurgery department. Coming up with a specific budget is advantageous and will go a long way to showing leadership you have been thoughtful about the funding you are requesting. If the startup investment is not enough to purchase the equipment that you need for your research lab to be successful, you need to explain this to the head of the potential departments you are possibly joining. It is also important to determine if there is a date limit to spending your startup (at which point it goes back to the department). Please see **Appendix 1** for an example of requests for startup funding.

b. Hiring Staff

To start your lab, consider hiring 1-2 technicians, and perhaps a post-doctoral fellow, should your skills and funding allow. Technicians must have the necessary skill set to carry out day to day laboratory operations, and possibly handle some of the administrative tasks of the lab such as budgeting, ordering and inventory maintenance / organization. A post-doctoral fellow will be a more advanced scientist and hence more independent, but will also require training and promotion on the pathway to research independence.

An important consideration will be the ability of your staff to work somewhat independently and without your feedback for swaths of time given your clinical duties may keep you away from the lab for days at a time. While starting a lab requires focus on the task at hand (running a lab), consider your staff's needs and goals in terms of career development when hiring. Your institution should have resources for you in order to perform annual performance evaluations and to determine the skills and needs of your staff – study up on these and be attuned to your staff's career development goals to make sure it's a good fit for what you can provide. Make sure to budget for both salary and fringe benefits when considering hires.

Residents and students will also express an interest in contributing to the lab. Welcome them with open arms should your bandwidth allow. These team members can be valued contributors for much less (if any) cost, and their training is highly rewarding.

Graduate students (PhDs or MD, PhDs) require a significant amount of training and time. If you consider this option, it's probably best to first co-mentor one with one of your mentors as they will likely have more time and experience than you. This could be a great learning opportunity for you as well.

c. Equipment and Supplies

Your equipment and supply needs will vary based on the work you are planning to pursue. However, most labs need basic supplies and equipment, which are listed in **Appendix 1** for your consideration. You can also request this information from recently recruited faculty or your mentor, and lab managers in your department. Importantly, your institution may have direct contracts with specific vendors, and your department or

mentor works with specific instrument and equipment representatives to outfit their research needs. Seek out these individuals for assistance with lab startup bundles. Often they offer deep discounts and free materials for new labs.

III. Obtaining Funding

a. Sponsored Research Infrastructure

At most institutions, your research funding must go through your research administration team. This includes NIH funding, foundation funding and private donations. Get to know the officers in your office of research administration, they are a resource to help you navigate grant application requirements. They can help with budgets as well as regulatory and administrative paperwork. Often grant applications need to be routed through institutional channels with the support of sponsored research prior to submission, and many institutions have deadlines for this one to several weeks in advance of a grant submission deadline, so plan your applications accordingly.

b. Development and Philanthropy

Private and foundation philanthropy is often a significant source of laboratory funding. As a junior faculty member, its beneficial to reach out to your institution's development team as a first step. Often there is a particular officer assigned to each department / division, and they will be aware of the contributors to your group. These individuals can also help to raise money on your behalf as they have deep connections with the giving community, so it is strategic to request a meeting with the team to introduce yourself and your research. Working together, you can draft materials and an elevator pitch that can be used to entice donors. Over time, it is important to develop relationships with foundations and donors who will advocate on your behalf.

c. Grant Writing and NIH funding

Grantsmanship is an imperative skill as a primary investigator, in order to obtain sustainable laboratory funding. As a junior faculty member, there will be ample requests for applications (RFAs) for a variety of funding opportunities, giving you the opportunity to develop your grant writing skills. Your goal through these opportunities should be to gain funding that will help you develop as an independent investigator, and to improve your grant writing over time. Your institution likely has programs and workshops for grant writing and development, seek these out and gain skills from these opportunities. In the unlikely event that no such opportunities exist at your institution, develop a peer group and work with your mentor to review and revise grant applications together. This feedback can be invaluable in developing your proposals, and reading other people's grants can give you insight into your own submissions.

Another exceptional resource is The Grant Application Writer's Workbook – NIH Version (https://www.grantcentral.com/workbooks/national-institutes-of-health/). This step by step guide will enable you to write in a manner that is favored by the NIH, and helps you learn the skills of grantsmanship. As a junior faculty member your first goal should be to obtain K-level funding. There are multiple programs available. The traditional approach is to apply for the K08 Mentored Career Development Award through an appropriate institute for your research focus. Another option, if your institution has a CTSI grant / program, is to apply for an institutional KL2. Lastly, there is an incredible opportunity through the NINDS to apply for a neurosurgeon-specific career

development K22 grant, applicable for clinical and basic science researchers: https://www.ninds.nih.gov/funding/training-career-development/postdoctoral-fellows/career-transition-award-ninds-intramural-clinician-scientists. All are excellent first steps for NIH funding your laboratory. The ultimate goal is a K to R transition in 3 to 5 years, signaling an emergence to research independence.

d. K12 neurosurgeon research career development award

Consider applying to the K12 neurosurgeon research career development award. This is a difficult to obtain early career award but all who apply are required to attend a 3-day workshop on becoming a neurosurgeon-scientist. The level of mentoring and advice at this workshop is unparalleled. You will have a chance to have your K/R award critiqued and reviewed and obtain valuable feedback. Moreover, you will hear from key NIH personnel (e.g. Steve Korn) who want neurosurgeons to succeed at obtaining NIH grants. You will interact with some of the most successful neurosurgeon-scientists in the country at this meeting.

IV. Identifying Mentors

Although this section is #4 on this research guide, it is probably the most important section to focus on when starting out on your research career. As a neurosurgeon-scientist, you need someone who is not just a mentor but someone who is invested in your lab's results, manuscripts, grants, and overall success. No one develops a long-standing NIH funded lab without the help of strong relationships with key mentors in your field.

a. Institution Resources

Success as a neurosurgeon scientist will depend on mentorship from others who have experience and resources to support you. You will need multiple mentors who have expertise in different areas to support you and your career development.

First, the above mentioned K level NIH awards are mentored career development awards, so these require you to have a primary mentor, and an advising and collaborative team of additional mentors and senior faculty to promote your growth and development as a scientist. You should identify a primary mentor as soon as possible, enlisting the guidance of your chair and other faculty familiar with your research interests who may be able to steer you towards the appropriate collaborators and mentors at your institution. It is likely that you may have already identified this individual in considering your faculty position at this institution and the focus of your research. Seek out as many people as you can, learn about their work and how it may dovetail with yours. It is absolutely critical that you find mentor(s) who are the absolute best in their/your field. Find individuals who are willing to share resources and teach you new skills, or support your research by providing the opportunity to collaborate with their staff who have the skill sets you need. As K awards are career development awards, an aspect of the application that receives great consideration is how will the research you propose in the grant allow you to learn and grow towards research independence – the way you do this is to learn from others who have done it themselves and (ideally) mentored others to do the same. Importantly, your research needs to find a unique path from your mentors.

Next, you should identify your senior panel of support. This can consist of your division head, your department chair, chairs from other departments, the head of a cancer or other focused center, etc. Reach out to these people and get to know them as they can be a great source of knowledge / support and lend considerable credibility to your grant applications (think: letters of recommendation and internal review panels that gauge and monitor your research progress over time). Many institutions also have formal mentoring programs that pair junior and senior faculty to help them navigate the professoriate. If this is available at your institution take advantage of it. Every junior faculty member should have a mentor outside their field that can give them a unique perspective and help them thrive academically. Consider, too, that your mentoring committee should consist of clinicians, scientists, and clinician scientists – all have valuable perspective to offer.

Looking outside your institution will be important for your mentorship. No institution has all the mentor expertise you will need for ultimate success. The ease of video conferencing such as Zoom has changed the way many institutions, labs, and individuals interact with each other. Video conferencing has made interacting with experts at other institutions easy to with important face-to-face communication. Inviting these outside mentors to your institution for important in-person interaction will also be key to solidifying these relationships.

Lastly, consider additional institutional resources that may exist. For example, your institution may have a grant writing club, junior faculty group, or writer's workshop where you can connect with your peers who may also serve as a source of mentorship and support. There may be individuals in your academic community at large, outside of the school of medicine, who have a track record of supporting junior faculty or aspects of their work that may complement your own. Your institution may have sponsored programs for teaching and mentorship, junior faculty development, and sponsored research. For example, if your institution offers a KL2 award, part of that programming is to meet on a regular basis with other awardees and senior faculty willing to provide additional mentorship. Get to know these resources and seek out individuals who can help you identify programs of value at your particular institution.

b. National / International Resources

Identifying additional faculty and scientists is another important way of gaining insight, support and resources. Take some time to think about the leading researchers in your line of inquiry and seek them out. Attend national meetings and introduce yourself to speakers and organizers. Multiple surgeon scientists routinely attend the AANS/CNS Peds section meeting, ASPN, ISPN, AANS, and CNS as well as other subspecialty conferences nationally and internationally. Use the NIH RePORTER site to look up others who may be doing similar research, or to find NIH (particularly K) awardees at your institution and beyond: https://report.nih.gov/.

V. Balancing a Clinical Practice with Research

a. Integrating Research and Clinical Work

One of the greatest challenges to succeeding as a neurosurgeon scientist is striking a balance between your clinical responsibilities and your academic research output. It is difficult to achieve success without at least 50% protected time for research, and even

with this amount it is easy for a busy neurosurgical practice to encroach on this time. In order to help protect one's research time, it is important to be thoughtful with your call schedule by blocking off swaths of time for research activities. Many find it advantageous to group clinical time at the start (or end) of the week, and research at the opposite end of the week. Some institutions utilize a "surgeon of the week" model where call responsibilities are clustered to a given week, leaving the remaining weeks of the month free for academic pursuits. A similar approach could be utilized for research, where specific weeks are carved out specifically for research to protect that time. These are points to negotiate with your partners and division head. **However, in general, research productivity is going to be most successful when you are thinking and doing it all the time blended in with your clinical responsibilities. Finding the balance between the two is critical for success (see below). Finding a unique niche of research and clinical work is difficult but will set one up for the long-term success at obtaining extramural grant support and with manuscript productivity.**

A second consideration is time spent on inpatient / service management. As a pediatric neurosurgeon with patients in the ward, you will be seeing patients daily and dealing with their needs throughout the day. Good communication with your inpatient team (residents, advanced practitioners and your partners) delineating when you will be in touch with a care plan and when you will be unavailable due to research activities goes a long way to limiting interruptions during productive research time (writing, etc).

Likewise, making it very clear to your laboratory research team when you will be available to them is imperative for them to plan experiments and feel you are accessible to them. Checking in with your team members on a weekly basis, both individually and as a group, helps you keep on top of their activity and troubleshoot any challenges that may arise. If you can, it is helpful to do work physically in the lab or a nearby office when possible, so you can have face to face contact with your team on a regular basis.

When possible, it is exceedingly helpful to attempt to integrate your clinical pursuits with your laboratory research interests. This enables you to seamlessly move from one realm to the other. As you build your clinical practice, do your best to focus on the patient populations(s) that correspond with your research queries, as this will help productivity in both realms. Also remember to engage and thank your partners, whose work helps support your endeavors – a good way to do this is to include them as authors on your papers, or co-investigators in your grants.

b. Research Focus and Productivity

As mentioned, its best to try to focus your area of inquiry to something that you practice clinically as well, in order to merge these endeavors and increase academic productivity. You should aim to produce both clinical and basic science papers (if you have a basic science laboratory as your research enterprise). A good goal is to aim for $\geq$2 publications a year. This is a good general rule, but some care should be taken as to where these papers are published. You will need to prove that you can publish in some higher impact journals in your field and not just open access or clinical journals. The NIH study section will know which journals demand the proper rigor for the scientific method. This will help you build your CV and make a name for yourself in the field. You should also regularly submit to professional conferences and participate with posters and talks where

accepted (see below). Lastly, its good to have multiple projects ongoing in the lab as guided by your grant funding.

c. Promotion and Tenure

Seek institutional guidance for considerations around promotion and tenure early. Even as junior faculty, you should be planning for promotion and keeping an eye on building your dossier. Most institutions have faculty development support that can help with determining requirements for application for promotion, such as reference letters and CV format. Another excellent resource is: https://www.facultydiversity.org/dashboard. Discuss the expected timeline for promotion with your chairman early in your career in order to ensure you stay on track.

d. Conferences and Networking

CNS www.cns.org
AANS www.aans.org
Pediatric AANS/CNS Joint Section www.pedsneurosurgery.org
ISPN www.ispnneurosurgery.org
ASPN www.aspn.org
SNO www.soc-neuro-onc.org
ASCO www.asco.org
American Epilepsy Society
American Society for Stereotactic and Functional Neurosurgery https://www.assfn.org/
CURE Epilepsy https://www.cureepilepsy.org/
Hydrocephalus Association https://www.hydroassoc.org/research-overview/