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# Recognizing and Responding to the Needs of Future Child and Adult Neurology Care Through the Evolution of Residency Training

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Recent insights into the frequency of occurrence and the genetic and mechanistic basis of nervous system disease have demonstrated that neurologic disorders occur as a spectrum across all ages. To meet future needs of patients with neurologic disease of all ages and prepare for increasing implementation of precision therapies, greater integration of child and adult neurology residency training is needed.

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While most child neurologists do not practice adult neurology or general pediatrics, it is common for child neurologists to care for patients well into their adult years as well as to address pediatric issues in patients with complex, chronic neurological conditions. With advances in targeted and supportive care, increasing numbers of children with chronic neurological conditions are surviving into adulthood. At the same time, neurologic diseases formerly considered to afflict only adults are now recognized to occur frequently in children. In addition, there is a growing recognition of relationships between rare pediatric neurological diseases and familial risk for adult-onset common conditions. Most adult neurologists, due to lack of exposure and experience, are not well prepared to care for patients with complex childhood neurologic diseases who

survive into adulthood. It is now clear that neurologic diseases occur as a spectrum across all ages making it imperative that both child and adult neurology residents are trained and prepared for this reality. There are parallels in other medical disciplines such as pediatric and adult cardiology which are separate specialties now in need of *new* integration of cross-training between adult and pediatric cardiology.<sup>1</sup> Neurologists working in the remainder of the 21st century will need to better understand lifespan issues as well as emergent neurological therapeutics. These needs will have implications for training— to enhance the cross-training of child neurology focused for adult and adult neurology focused for child.

Over the past decade or more, there has been growing discussion about the current state of training

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requirements for child neurology residents. It has been proposed to reduce or eliminate mandated adult neurology training, triggered by a survey of 116 child neurology residents.<sup>2</sup> This discussion is in the context of a nationwide shortage of neurologists,<sup>3,4</sup> both child and adult, and increasing regulatory and financial pressures on our learners. We are concerned that such an adjustment in neurology training would be harmful to the preparedness of future child and adult neurologists caring for patients with neurological conditions across the lifespan.

Most of the revisionary focus related to child neurology residency training requirements has been on the mandatory 12 months of adult neurology rotations and potentially reducing or even eliminating these rotations. There has been less discussion of how that time is spent,<sup>5</sup> and how the curriculum for neurological training should be modernized for all learners to better represent not only the increasingly significant lifespan demands described above, but also 21st century neurological therapeutics particularly disease-modifying therapies, genetic therapies, and precision or individualized therapeutics. Both child and adult neurology residents must learn the steps required for transitioning from pediatric to adult care which can be challenging, creating vulnerabilities in care continuity, and potentially safety concerns. In addition, there are numerous examples of disorders that combine adult and pediatric care in a multidisciplinary manner. Examples include neurocutaneous disorders, neuromuscular disease, traumatic brain injury, migraine, autoimmune disorders, and epilepsy.

We are concerned that a direction that further limits neurologists-in-training from such experience and exposure would be harmful to the preparedness of both child and adult neurologists to care for patients with neurological conditions across the lifespan. The current and future state of neurology for both children and adults mandates modernizing the curriculum for all residents. To address the anticipated needs of neurology patients, now is the time for further thoughtful integration, not separation, of child and adult neurology training.

We have outlined several points below that we feel should be very carefully considered in the discussion of any changes in residency training. These build on a recent influential editorial.<sup>6</sup>

- The curriculum and patterns of training for both child and adult neurologists should be modernized to better reflect the advancements in neuroimmunology, genetics, and gene-targeted therapy. This modernization may mandate a shift in the focus of training from inpatient to outpatient rotations, as well as the development of specific curricular material to “upskill” our learners in the field of genetics.
- A specific focus on enhancing the continuity of care across the lifespan should be integrated into neurology training, again for both child and adult neurologists. The aim would be to deliver equitable and evidence-based care with a greater focus on the impact of intellectual and developmental disorders and the “exposome” (including not only nutritional/biochemical/environmental exposures, but also trauma/stress-related exposures) in both pediatric and adult patients. For child neurologists, a fundamental understanding of adult neurology, including the outcomes of diseases that begin in childhood and knowledge of novel therapies utilized in adults that may also have applications in children and adolescents is critical. Likewise, a foundational understanding of the origin of neurologic disease during early development is certain to benefit the patients of adult neurologists. Pediatric and adult neurology should represent a continuum, with close interaction between the two groups fostering, especially through training, advances in research and clinical care across the lifespan.
- Given that advances in translational neuroscience more often face fewer regulatory limits for clinical trials in adults, many disease-modifying treatments, devices, and diagnostics are first approved for use in adults. Child neurologists who are knowledgeable about these advances in adult neurology can more rapidly assist in supporting and assessing the use of these new treatments and diagnostics for use in the pediatric population. If not, there will continue to be a significant divide between the application of new advancements in the pediatric versus adult population.
- We contend that a greater emphasis during adult neurology training should be placed on intellectual disorders, developmental disorders, and the continuum of care. In a reciprocal manner, there should be additional training in the outpatient management of adult medical, neurological, and biopsychosocial issues for the child neurologist who manages patients transitioning into adulthood.
- Any changes in training should ideally be carried out in a relatively uniform manner across all training programs, where feasible, so as not to disadvantage residency programs of varying size and/or resources. Obviously, some programs may not have the resources to provide elements of the “modernized” training with ease. Achieving these aims may therefore require the provision and distribution of teaching material by our professional societies, or opportunities for specialized rotations in other programs to meet new requirements.
- The medical acuity and complexity of hospitalized neurology patients continues to increase, and may raise concerns for the adequacy of supervision for night-call

residents. Child neurology residents, who have typically no adult medicine training aside from their medical student rotations, may feel uncomfortable when they are on call overnight caring for adult patients with complex medical conditions. Modernization should increase focus on neurology decision making and less on general medical care. The beneficial impact on resident morale and well-being of less night call (for both child and adult neurology learners) will need to be balanced against the opportunities for learning and decision-making that accompany night call. Accreditation Council for Graduate Medical Education (ACGME) and Residency Review Committee (RRC) approval would of course be required for any substantive change in the balance of inpatient/outpatient training.

- The length of training for child neurologists (5 years for most) compared to adult neurologists (4 years) has been raised as one reason why a smaller proportion of child neurology residents select to do fellowships. Restructuring the time spent on inpatient activities during residency training for child neurologists might allow for the inclusion of fellowship style training, for example, in neurophysiology, imaging, or genetics during residency.
- There is also concern that the 2 years spent training in general pediatrics is too long and that board certification in pediatrics is not necessary for child neurologists.<sup>2</sup> This concern must be balanced by consideration of the need for child neurology residents to be thoroughly trained to care for infants, children, and adolescents. What is critically important is the ability of a child neurologist to fully assess complex conditions that affect children that impact the nervous system and the comorbidities that accompany neurological disease. Indeed additional training time can be justified because child neurology encompasses training around dynamic developmental events of the most complex organ system.

The Flexner report of 1910 stimulated major changes and improvements in medical student education in this country. It was controversial and led to the closure of some medical schools. The report was, however, a measured and systematic review of the state of US medical education at that time. We believe that any changes in neurology training should be conducted through an

equally measured approach that is based on foundational heuristic principles. Strong opinions are important, for sure, but modernizing neurology training is just too important for the next generation of neurologists, and for our patients. Now is the time for further thoughtful integration, not separation.

This Viewpoint commentary represents the personal opinions of the authors and is not an official or endorsed position by either the American Neurological Association or the Child Neurology Society.

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## Author Contributions

All authors contributed to the content, writing and review of this manuscript.

## Potential Conflict of Interest

No commercial products or references to specific therapies are made in this manuscript, which is largely a commentary. The authors report no conflicts of interest.

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