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## NEUROLOGY EDUCATION IN RESOURCE-LIMITED SETTINGS

The staff of many academic and private neurology practices in the United States exceeds the number of neurologists in all of Sub-Saharan Africa (excluding South Africa). As of 2004, there were approximately 3 neurologists per 100,000 population in high-income countries.<sup>1</sup> This figure dropped by a factor of 100 to 3 neurologists per 10,000,000 in low-income countries, some of which do not have even a single neurologist. There is, however, no shortage of neurologic disease in countries with few or no neurologists. In fact, the majority of disability-adjusted life-years and deaths due to neurologic diseases occur in the countries where neurologic resources are most limited.

Diagnosis and treatment of neurologic disease in countries with few or no neurologists often falls under the purview of internists and pediatricians, since they typically have no recourse to a neurology consultation. But where does their neurology training come from if there are no local neurologists to train them?

Through educational collaborations, neurologists have much to offer that can advance the care of the majority of the world's neurologic patients. Indeed, the foundation of capacity building in neurology in such settings is education.

When working in resource-limited areas, some version of the following question is inevitably posed to neurologists: "You may be able to help physicians localize and diagnose neurologic disease, but then what?" This is a variation on the theme of the hackneyed question posed to neurologists practicing in any setting. While neurologists in high-income countries can respond by recounting the latest therapeutic advances in neurology, the question is worth considering carefully in resource-limited settings. Neurology, like any science, is at its core a descriptive endeavor. Where diagnostic and therapeutic options are limited, description is the doorway to understanding. In any setting, making a diagnosis, even if of an untreatable condition, can allow for education of the patient and his or her family about prognosis.

While neurologic practice in resource-limited regions may reveal untreatable diagnoses, the value of understanding the principles of neurologic

localization should not be underestimated. A patient seen in one such setting presented with acute-onset facial weakness and hemiparesis, and was correctly diagnosed as having had a stroke. The patient's facial weakness was contralateral to the hemiparesis and in a lower motor neuron pattern. It had not been initially observed that the patient was unable to close her eye on the affected side, which, left unattended, had developed a severe exposure keratitis. While the exercise of localizing the stroke to the pons may have been academic, knowledge of the possible deficits for which to evaluate when a facial palsy is present can prevent disabling complications such as this. More generally, 2 of the most common neurologic disorders worldwide, stroke and seizure, are ultimately clinical diagnoses. The majority of the world's stroke deaths and untreated epilepsy cases occur in lower-income countries,<sup>2,3</sup> where accurate diagnosis is the first step in beginning to understand disease burden, identify and reduce treatment gaps, and increase preventive efforts.

For neurologists practicing in high-income countries, our examination- and localization-based approach may seem quite different from that of our non-neurologist colleagues. This feels less the case in resource-limited areas, where limited diagnostic testing engenders extraordinary clinical skills. Teaching the subtleties of neurologic localization therefore seems a natural extension of local practice. Explaining a pupil-sparing third nerve palsy, a Kernohan's notch phenomenon, or a Hoffmann sign can provide valuable tools to the armament of already exceptionally nuanced local bedside diagnostics.

Neurologists are often asked, "What use is bedside localization when we now have MRI?" We may counter by explaining how the bedside examination guides both the need for imaging and the interpretation of imaging findings (or lack thereof). This too is an increasingly important aspect of clinical reasoning in neurology in regions where neuroimaging has only recently become available, albeit in limited quantity due to cost and accessibility. For which patients will neuroimaging clarify a differential diagnosis, change management, or yield prognostic information, justifying the cost? How should neuroimaging findings be interpreted? The answers to these

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questions are at the bedside, and educational efforts in neurology must focus not only on clinical neurologic diagnosis but also on when and how to use and interpret neuroimaging when resources are limited. Indeed, such lessons learned will inevitably serve us in high-income settings, where we will not indefinitely be able to rely on near-infinite access to neuroimaging studies.

In addition to the education that neurologists can provide where there are few or no neurologists, our own education is also deepened in that process. Beyond learning to broaden differential diagnoses to include local infectious and noninfectious diseases, one is forced to go as deep as possible at the bedside. Such clinical decision-making is admittedly hard to oblige oneself to do in high-resource environments, where advanced diagnostics are readily available as gold standards to aid in our reasoning. Indeed, many of the esteemed elder neurologists whose clinical wisdom inspires us through their textbooks or practice trained prior to the widespread availability of neuroimaging. To some extent, the acquisition of such clinical wisdom is born of necessity. The clinical skills fostered by work in resource-limited settings can allow for important reflections on our domestic practice of neurology. In addition, the questions that arise in this process can inform and inspire further educational endeavors, research collaborations, and perhaps even guidelines and policy. The latter are markedly absent where they are most needed.<sup>4</sup>

Perhaps equally if not more important than contributing to the development of neurologic capacity through education would be inspiring students or residents in countries with few or no neurologists to consider a career in neurology. Educational efforts hold this potential promise, as evidenced by the collaboration between US neurologists and the Addis Ababa University Faculty of Medicine Black Lion Hospital in Ethiopia, where there is now a self-sustaining neurology training program.<sup>5</sup>

The World Federation of Neurology<sup>6</sup> and the American Academy of Neurology Global Health Section<sup>7</sup> are among the leaders in spearheading efforts to develop educational resources and programs with our colleagues abroad. Following are some general recommendations for those interested in becoming involved:

- If travel is not possible, one can collaborate with colleagues abroad on educational resources on the diagnosis and management of neurologic disorders in resource-limited settings.
- If travel is possible, one should collaborate with a site where there is an established primary care and educational infrastructure. As a consultation specialty, neurology efforts require collaboration with established medical systems. Ideally one should be able to speak the local language in order to interact

with physicians, nurses, physician extenders, residents, and students. Plan to go for no less than 1 month at a time.

- Ask what questions and topics would be helpful to discuss, and prepare in advance by reviewing literature on the epidemiology, diagnosis, and treatment of neurologic disease in the region.
- See patients with local staff—not only neurology patients—to develop a sense of the range of health and disease in the region as well as local clinical practices.
- Understand local guidelines and teach in the context of those guidelines.
- Seek to understand the availability (and consistency of availability) of diagnostics and treatments and incorporate this into your teaching.
- Establish ways for your collaborators to continue to contact you to discuss new cases and evolution of cases you have seen after you have left.
- Return regularly and maintain active correspondence in the interim.
- Ideal(istica)ly, seek to inspire what may be that country's first neurologist(s).

The majority of the world's neurology patients and their providers eagerly await your collaboration.

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