

Teaching: Residents in the hospital, mentors in the community

The Educational Pipeline Program at Penn

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As young physicians embarking on careers, many of us have benefited from exceptional teachers and role models, and we aspire to become equally inspiring mentors. In many institutions, neurology house staff enjoy reputations as outstanding educators of medical students and other physicians-in-training. Neurology residents and fellows, however, may overlook opportunities outside the walls of their institutions to act as mentors and educators in their local communities. It can be difficult to participate in community outreach during training due to time limitations imposed by busy residency or fellowship schedules. A critical first step is to establish meaningful relationships within the community, a process that can be facilitated by collaboration with existing outreach programs. Adopting this strategy, neurology house staff at the University of Pennsylvania have become instrumental in the ongoing success of the School of Medicine's Educational Pipeline—a multi-tiered mentorship program that teaches fundamental principles of medicine and neurology to inner city high school students in Philadelphia.

The University of Pennsylvania Medical Pipeline Program began in 1998 as part of *Project 3000 by 2000*, an ambitious program launched by the Association of American Medical Colleges, Division of Community and Minority Programs, with the goal of increasing the matriculation of underrepresented minority medical students. Responding to a growing need for knowledgeable clinician-educators and experienced mentors, neurology residents began directing the curriculum of the Pipeline Program in 2005.

METHODS Participants. The Pipeline program has drawn students from three institutions: William L. Sayre, Thomas A. Edison, and Overbrook high schools (figure 1). According to 2005–2006 data from the School District of Philadelphia, 77.8% of Edison students are Latino and 19.3% are African American. The student bodies at Sayre and Overbrook are 98.5% and 98.8% African American, respectively. Additionally, 84.5% of Edison students, 61.7% of Sayre students, and 70.7% of Overbrook students were eligible for the Federal School Lunch Pro-

gram in the 2005–2006 school year.¹ The demographics of students participating in the program closely reflect those of their home school.

A faculty coordinator at each school selects interested students for the program. Students who perform well in the neuroscience component of Sayre's life science curriculum are encouraged to enroll in the Pipeline. The Pipeline program counts toward a Philadelphia Unified School District requirement that students participate in activities that are of civic value. The number of students enrolled annually has ranged from 25 to 46.

Each year the Pipeline recruits between 8 and 12 University of Pennsylvania undergraduate students and 10 to 25 medical students. In 2005, 8 neurology residents taught in the program. In 2006, 7 neurology residents and 1 fellow participated, representing about one-third of the 21 adult neurology residents. The estimated time commitment for each resident is 3 to 6 hours per year. A single fourth-year medical student serves as a logistical coordinator, ensuring the smooth day-to-day operation of the program.

Structure. Pipeline sessions are held at the University of Pennsylvania School of Medicine weekly during the spring school semester. Neurology house staff create the clinical vignettes around which the class is structured and give preparatory lectures to the medical students and undergraduates in order to enrich their understanding of the subject matter and to help them generate ideas for teaching the high school lessons.

Teams of two or three first-year medical students and a fourth-year medical student lead the sessions for the high school students with undergraduate students acting as teaching assistants (TAs). Each TA supervises two to four students and serves as a small-group facilitator during class activities. Residents and fellows take turns attending the high school class sessions, and serve as an additional teaching resource for the medical students and undergraduates. Sessions are 90 minutes long.

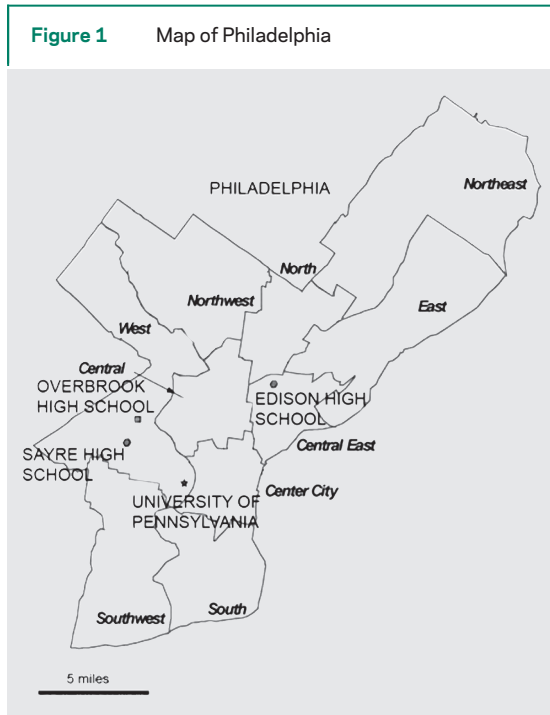
Since 2005, the high school students have concluded each year's course by giving final oral presentations on topics in neurology. The final public speaking exercise is attended by the students' parents and faculty from the University of Pennsylvania. The program is funded entirely by the University of Pennsylvania School of Medicine. The current annual budget is \$2,600.

Curriculum. The course covers three cases per year; each is covered in three weekly class sessions. The 2005 curriculum focused on basic neuroanatomy, elements of synaptic transmission, and the intracellular constituents of neurons. The cases used to underscore these themes were an epidural hematoma,

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Map of Philadelphia showing the University of Pennsylvania and the high schools that have participated in the Pipeline: Overbrook, Edison, and Sayre.



Parkinson disease, and new variant Creutzfeldt-Jakob disease. The 2006 curriculum featured cases that highlighted the neurologic manifestations of common medical illnesses such as hypertension, alcoholism, and HIV. The related cases were a hypertensive cerebellar hemorrhage, Wernicke-Korsakoff syndrome, and CNS toxoplasmosis presenting as a seizure.

The didactic sessions that neurology house staff give to medical students and undergraduates employ clinical vignettes resembling those used in the problem-based curricula of many medical schools. Residents and fellows teach the clinical presentation of diseases, neuroanatomic localization, differential diagnosis, pathophysiology, and treatment (figure 2).

The medical students use the information provided by the neurology residents and fellows to generate lesson plans that are accessible, interactive, and engaging for the high school students. While these lessons are loosely structured around the cases written by neurology house staff, much of the class time is devoted to teaching exercises that illustrate basic concepts about the nervous system and neurologic diseases. Skits, games, props, models, and humor are routinely incorporated into the lesson plans. There are no required textbooks and the students are not assigned outside reading, but they receive short homework assignments based on the material covered in class.

In 2005, students prepared group oral presentations and performed patient-physician dramatizations related to the cases covered during the course. In 2006, the students gave more in-depth oral presentations that fell into four broad categories: neuroanatomy, seizures, stroke, and neurologic complications of alcohol abuse. Within the groups each student researched and presented a specific topic. For example, A.W., a 17-year-old in the 11th grade at Sayre, presented the neuroanatomy of the limbic system, which had not been covered during class. He discussed the role of the hypothalamus in autonomic and endocrine function, the amygdala in emotional conditioning and fear responses, the nucleus accumbens in reward signaling, and the hippocampus in memory formation. Finally, he touched on the mammillary bodies as a location affected in amnesic patients with Wernicke-Korsakoff syndrome.

Because many students did not have access to computers or the Internet at home, the two final class sessions were spent preparing the presentations. Neurology house staff attended these sessions and answered questions on the topics that students had chosen, directed them to appropriate online review articles and neurology-related Web sites, and helped them to develop the computer skills required to prepare their talks. The participating neurology fellow reviewed the students' computer slides for the final presentation in order to ensure accuracy.

Feedback. Every year medical students provide written feedback at the conclusion of the class. In addition to giving open-ended comments, they are asked to assess whether the Pipeline has improved their ability to communicate medical information and whether they feel it will enrich their future patient-physician relationships. High school students provide informal feedback to their faculty coordinators, who use this information to recommend improvements to the curriculum. In addition, 10 students who participated in the Pipeline in 2005 and 2006 were asked to give videotaped exit interviews describing their experiences. Students were asked how they felt the Pipeline had benefited them and how it had impacted their long-term goals.

RESULTS Since 1998, 313 high school students, 110 undergraduates, and 165 medical students have participated in the Pipeline. A total of 211 high school students (67.4% of participating students) have completed the program. The addition of a more rigorous curriculum and a final presentation requirement has not detracted from course completion rates. Between 2005 and 2006, 67 students participated in the program and 53 (79.1% of participants) successfully completed the final public-speaking exercise.

Medical and high school student feedback for the Pipeline program has been positive. Of 165 medical student participants, 148 (89.7%) felt that the program had improved their ability to communicate medical information, and 127 (77.0%) indicated that what they had learned would be applicable to future physician-patient relationships. Medical students unanimously (165 of 165) endorsed the Pipeline Program as a positive experience and wrote that they would be interested in teaching in the program again.

Praise for the program was similarly unanimous among the 10 high school students interviewed; 5 of them (50%) stated that the Pipeline program had led them to consider careers in medicine. For example, when asked about the impact of the Pipeline on his long-term goals, A.W. commented, "I'm trying . . . to reach my goal to be a doctor. I[ve] still got a positive attitude to be a doctor . . . to be the most committed doctor of them all. The Pipeline program influenced me to try to be a neurologist."

Some students' interest in medicine has endured

Figure 2 Illustration of the teaching pathway of the Pipeline program

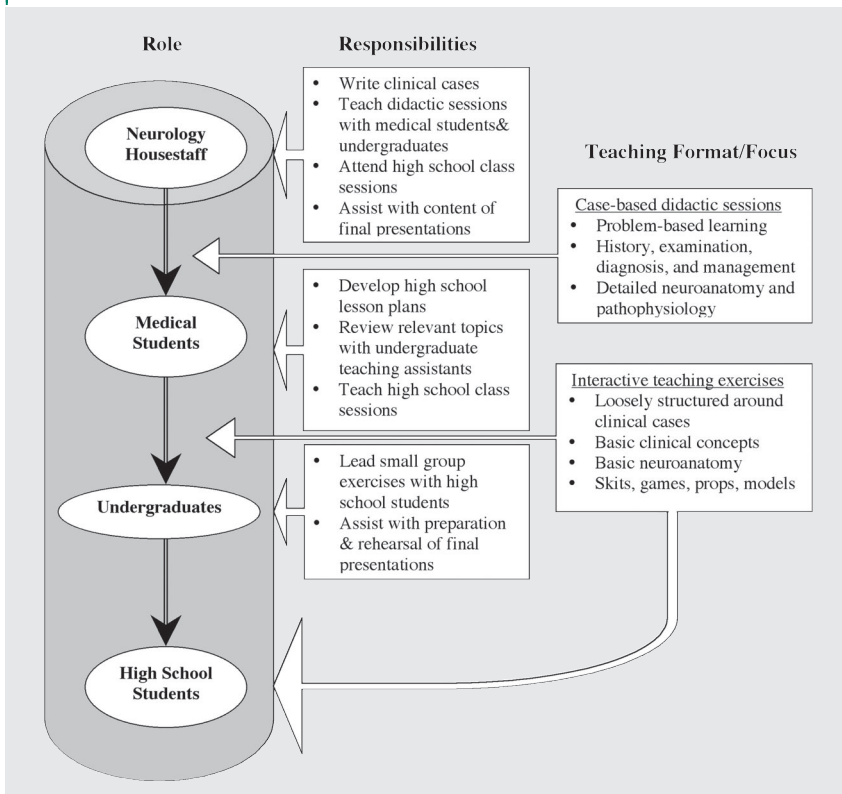


Illustration summarizes the roles and responsibilities of neurology house staff, medical students, and undergraduates.

long after completion of the program. Two students from the 2006 Pipeline participated in the National Youth Leadership Forum on Medicine the following summer, and one will be attending a “Mini-Med School” course at Drexel University in the spring of 2007.

DISCUSSION Strengths of the Pipeline Program. The Pipeline provides mentorship and education for students at all levels. High school students are taught by undergraduates, who are guided by medical students, who, in turn, learn from neurology house staff. High school students are exposed to academically successful mentors who are at three different stages of training, and they are able to gain valuable insight into the processes of going to college, entering medical school, and training to practice as a medical specialist. The success of this multi-tiered approach is consistent with prior evidence suggesting that programs that employ advanced students—such as undergraduates or medical students—as teachers for high school students are effective and efficient at educating both high school students and the older students who teach them.² The feedback we have received from high school and medical students indicates that they feel the program helps to prepare them for the next stage of their education, and a number of high school students reported that

the program has led them to consider a career in medicine.

The Pipeline program provides neurology residents with the opportunity and means to meaningfully contribute to their community as instructors and mentors. In doing so, they improve their teaching skills and increase both the breadth of their knowledge of common neurologic illnesses and their understanding of the impact these conditions have on their community. Participation in the program also contributes to training in several of the core competencies delineated for neurologists by the Accreditation Council for Graduate Medical Education (ACGME). House staff develop interpersonal and communication skills, which includes “providing explanations of psychiatric and neurologic disorders that are jargon-free and geared to the educational/intellectual levels of patients and their families,” as well as professionalism.³

The structure of the Pipeline Program allows house staff to incorporate the classes into their busy schedules. A number of neurology residents and fellows share the responsibility for teaching the program, and many of the logistical concerns for the program are managed by the medical student coordinator. Because the curriculum is case-based, and because the material is conveyed with the assistance of medical student and undergraduate instructors, residents do not need to spend additional time outside of class preparing lesson plans and can rely on their pre-existing clinical expertise during didactic sessions. Finally, because the high school students are brought to the School of Medicine, it is convenient for neurology residents who work in the adjacent hospital to attend the classes.

Limitations. One of the major challenges facing the Pipeline is quantifying its impact in the community. It is important to know what effect the program has on the subsequent academic achievements of its students or on their eventual career choices. Data from similar programs suggest that early enrichment opportunities in biomedical science serve to increase the number of underrepresented individuals in medicine and related fields.⁴ The extent to which this holds true for Penn’s Pipeline remains to be seen. A second area in which the Pipeline has seen only limited success is in the continuity of mentorship. There is no formal mechanism in place yet for undergraduates, medical students, and neurology house staff to form long-term relationships with high school participants.

Future directions. A number of steps are being taken to address the limitations of the program. More outcome data will be collected from future Pipeline stu-

dents and retrieved from past students. A graduate student at the University of Pennsylvania School of Social Policy and Practice is planning an investigational study of past, present, and future Pipeline students. Mentorship opportunities will also expand. Plans are taking shape for medical students and undergraduates to visit and mentor students at their home schools and to involve students with neurologists in the hospital. For example, a number of high school students have enjoyed being trained as standardized patients for medical student neurology clerkship didactic exercises.

CONCLUSIONS There are many reasons for neurologists-in-training to pursue community-based educational initiatives. Neurology education can have a dramatic impact on public awareness of disease and health maintenance.⁵ Outreach to underserved communities can help break down social barriers that impede access to health care.⁶ It may also help to promote career interest in neurology, a field in which there is still marked racial and ethnic disparity.⁷ Programs like the Penn Pipeline may enrich the training experience of neurology house staff and allow busy residents to reaf-

firm their commitment to the community. We encourage our colleagues in other training programs to consider collaborating with their own institutions to bring neurology and neuroscience education to the underserved.

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