cost of training has increased substantially in recent years owing to a series of unfunded mandates, including more stringent educational requirements, decreased duty hours, and strict supervision requirements.

The cost of GME extends well beyond the costs partially covered by direct GME support. Investments in research and complex clinical activities are critical to the environment for robust, diverse training programs. No explicit investments in these additional costs are made in the current reimbursement system. When the Medicare inpatient prospective payment system was created, the adjustment for indirect medical education was made to serve as a proxy to partially reimburse teaching hospitals for the higher complexity of care and unique services that AMCs provide to communities. That adjustment is a hospital-specific payment intended to help support these institutional costs.[5] Highly specialized services such as burn centers would be at risk in the absence of this public support. For-profit hospitals that have a fiduciary responsibility to generate a financial return to shareholders are less likely to invest in burn centers and to have residency training programs.

Well-trained physicians require exposure to the full spectrum of health care for a broad patient population, diverse in demographic, economic, and health status, from the richest to the poorest, from the healthiest to the sickest, and with the most common to the rarest of conditions — all of which require investments beyond supervisory educational time. New physicians need exposure to the most well-established medical practices but also to the processes by which advances in prevention, diagnosis, and treatment are achieved.

As a potential physician shortage looms and the need for public investment in physician training grows, there have been calls for greater accountability for the public support that teaching hospitals receive to conduct physician education. The AAMC has endorsed legislation that would yield greater transparency of public support for AMCs but also more data on the costs incurred in maintaining a robust training environment. The same legislation would also create a reasonable system of rewards and penalties to ensure that AMCs train physicians who have the right mix of skills, can work in teams, are conscious of the finite nature of resources, and are able to develop better and more affordable systems of care. A continued and more accountable investment in GME-writ-large will benefit U.S. health care for decades to come.

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1. Newhouse JP. Toward a theory of nonprofit institutions: an economic model of a hospital. Am Econ Rev 1970;60:64-74.
2. Huderson A, Haberman M, Conroy J. Medicare patient hospital transfers in the era of health care reform. Washington, DC: Association of American Medical Colleges, 2013 (https://www.aamc.org/download/333654/data/april2013analysisinbrief-medicarepatienthospitaltransfersinthee.pdf).
3. Dzau VJ, Cho A, Ellaissi W, et al. Transforming academic health centers for an uncertain future. N Engl J Med 2013;369:991-3.
4. Medicare payments for graduate medical education: what every medical student, resident, and advisor needs to know. Washington, DC: Association of American Medical Colleges, 2013 (https://members.aamc.org/eweb/upload/Medicare%20Payments%20for%20Graduate%20Medical%20Education%202013.pdf).
5. Anderson GF, Lave JR, Russe CM, Neuman P. Providing hospital services: the changing financial environment. Baltimore: Johns Hopkins University Press, 1989:107.

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Tuberculosis Control in New York City — A Changing Landscape

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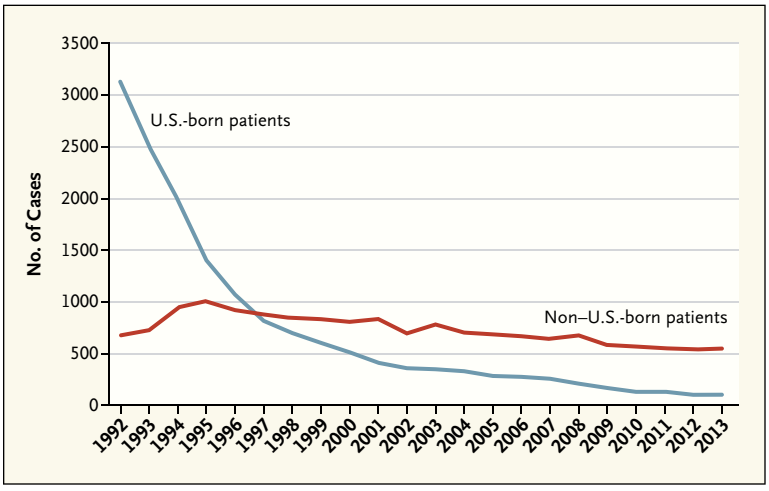
Since the introduction of chemotherapy for treating tuberculosis, political commitment and stable, sufficient funding have been the primary predictors of success for tuberculosis-control programs, and their absence has resulted in tuberculosis epidemics. Over the past decade, the federal funding for tuberculosis-control programs in the United States has decreased by more than 15%, even without adjusting for inflation, according to the Centers for Disease Control and Prevention. The incidence of tuberculosis continues to decline nationally, but in recent years



Number of Tuberculosis Cases in New York City, According to Birthplace, 1992–2013.

Patients considered to have been born in the United States include those born in U.S. territories. Data are from the New York City Department of Health and Mental Hygiene, Bureau of Tuberculosis Control.

the rate of decline has slowed, and some jurisdictions have seen increases in incidence. In New York City, which was the epicenter of the country's tuberculosis epidemic in the 1990s, overall funding for tuberculosis control has been cut by more than 50%, and in 2014 the city reported its first increase in cases after a decade of continuous reductions in annual tuberculosis incidence. Are we condemned to repeat history by reliving what has been called the "U-shaped curve of concern"?[1]

In response to the epidemic of tuberculosis and multidrug-resistant tuberculosis (MDR-TB) in the 1990s, federal, state, and city governments dramatically increased funding for tuberculosis control in New York City. Funding was used to improve laboratory diagnosis, ensure adherence to and completion of appropriate treatment regimens, improve infection control in hospitals, jails, and homeless shelters, and provide treatment for tuberculosis infection to select groups, such as recently infected contacts and people living with human immunodeficiency virus (HIV) infection.[2] Since the peak of the tuberculosis epidemic in 1992, New York City has increased the proportion of patients who complete treatment from 60% to more than 90%, reduced the rate of acquired drug resistance by more than 90%, nearly eliminated outbreaks in hospitals, prisons, and shelters, and documented a dramatic drop in the number of cases, from 3811 in 1992 to 651 in 2012.[3] However, in 2013, the number of tuberculosis cases increased by nearly 1% to 656.

This increase does not represent a new tuberculosis epidemic. Rather, it portends a new normal in tuberculosis control for New York City and possibly other large urban areas: a period of nondeclining tuberculosis rates and halted progress toward elimination. In low-prevalence settings such as New York City, tuberculosis programs have not fully adapted to the changing epidemiology of the disease, have not sufficiently leveraged innovation to control it, and have struggled to maintain adequate access to novel tuberculosis drugs and diagnostics.

In New York City, the current epidemiology of tuberculosis dictates that our focus must shift from primarily preventing transmission to treating tuberculosis infection in other high-risk populations. The profile of risk factors for progression to active tuberculosis has changed. HIV-associated tuberculosis has become less common; the primary risk factors now are diabetes, medication-induced immune suppression, and tobacco use. More important, more than 80% of people with active disease in the city were born outside the United States (see graph). They represent a mix of new arrivals and long-term residents, but we estimate that more than 60% of them were infected before they emigrated.

Our tuberculosis-program resources are currently devoted primarily to early identification and prompt treatment of people with active disease. We need to begin shifting those resources toward treating the large reservoir of infected people from which many of our cases now emerge. It is not clear, however, how to make that shift, because we cannot easily and reliably predict which persons are at the highest risk for progression to active disease. Furthermore, with the exception of infection in young children, we do not mandate reporting of tuberculosis infection, and it is challenging to locate asymptomatic adults and motivate them to take medications for 3 to 9 months.

One approach to preserving

the effectiveness of a public health program amid diminishing resources is to adopt new technology. Text messaging and e-mails are now being used to prompt patients to attend clinic appointments, provide them with test results, and allow them to report adverse reactions. Video conferencing with smartphones is being substituted for home visits to monitor ingestion of tuberculosis medications — an approach that is cheaper, more convenient, and less intrusive than conventional face-to-face directly observed therapy (DOT).[4] Whether video DOT will be as effective as conventional DOT is the subject of an ongoing study in New York City. Use of social media and other online resources can also help to locate potential sites of exposure, exposed contacts, and patients who have been lost to follow-up — information that was previously available only through labor-intensive interviews and medical chart reviews. One of the more ironic technological gaps in New York City is the lack of access to the latest diagnostic and outbreak-detection tools, some of which were developed in the United States. New technology such as the GeneXpert can rapidly detect drug-resistant tuberculosis but is prohibitively expensive for domestic tuberculosis-control programs. In addition, our ability to detect and investigate outbreaks could be greatly enhanced by whole-genome sequencing, but the cost of sequencing equipment and personnel to analyze these data remain out of reach for public health laboratories.

An audio interview with Dr. Macaraig is available at NEJM.org

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Historically, shortages of tuberculosis drugs were a concern only in the developing world, but now they are becoming increasingly common in the United States.[5] Since 2005, we have had shortages of drugs used to treat MDR-TB, and since 2012 we have seen interruptions in the supply of isoniazid, the mainstay of treatment for drug-susceptible tuberculosis disease and infection, and of tuberculin, which is used to test for tuberculosis infection. These recent shortages have nearly exhausted the inventory of New York City's tuberculosis program, threatening our ability to provide consistent, high-quality service to our patients. In contrast with shortages in the developing world, which are often attributed to lapses in funding, U.S. shortages are largely attributable to problems with manufacturing and supply.[5]

The New York City tuberculosis program is also greatly constrained by the high cost of tuberculosis drugs. A new 12-dose, once-weekly regimen of isoniazid and rifapentine for treating tuberculosis infection holds great potential for increasing completion rates. The cost of rifapentine, however, has made it difficult to expand this program. Despite the recent reduction in the price of rifapentine, the cost of a 12-dose isoniazid–rifapentine regimen is still four times that of 9 months of isoniazid, the standard regimen. In 2013, the city had to spend $20,000 to purchase a 24-week supply of bedaquiline to treat one patient with MDR-TB, an expense for which we do not routinely budget. Because nearly all MDR-TB cases in New York City are imported, we have limited ability to predict the number of cases we may encounter in future years, which makes it challenging to estimate funding needs. The expansion of the global MDR-TB epidemic makes it likely that New York City will need to find affordable ways to treat these patients.

The city spent more than $1 billion to curb its tuberculosis epidemic in the 1990s.[2] Much of that funding was used to develop a strong infrastructure for curing patients and interrupting transmission. Innovative and effective approaches to addressing gaps in tuberculosis control at the time, such as drug-susceptibility testing, genotyping, and DOT, were successfully adopted. Today, the changing landscape of tuberculosis in New York City demands new strategies for fur-

thering the progress that has been made in reducing tuberculosis incidence. These strategies must include approaches to addressing the reservoir of tuberculosis infection, to adopting new technologies to maximize the efficiency of our work, and to making tuberculosis drugs and diagnostics consistently available to all patients. The slowing decline in case rates and recent increase in cases demand that New York City adapt quickly in order to confront new challenges in tuberculosis control.

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1. Reichman LB. The U-shaped curve of concern. Am Rev Respir Dis 1991;144:741-2.
2. Frieden TR, Fujiwara PI, Washko RM, Hamburg MA. Tuberculosis in New York City — turning the tide. N Engl J Med 1995;333:229-33.
3. Bureau of Tuberculosis Control annual tuberculosis summary, 2013. New York: New York City Department of Health and Mental Hygiene, 2013.
4. Krueger K, Ruby D, Cooley P, et al. Videophone utilization as an alternative to directly observed therapy for tuberculosis. Int J Tuberc Lung Dis 2010;14:779-81.
5. Impact of a shortage of first-line antituberculosis medication on tuberculosis control — United States, 2012–2013. MMWR Morb Mortal Wkly Rep 2013;62:398-400.

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