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BUILDING EFFECTIVE INFRASTRUCTURES FOR HIV/AIDS CONTROL

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Nigeria, like many African nations affected by HIV/AIDS, faces the daunting task of responding to an unprecedented health emergency at the same time it needs to rebuild a dilapidated health infrastructure. An estimated 20% of the four to six million Nigerians already living with HIV/AIDS may need antiretroviral therapy (ART). In 2001, the Nigerian government launched what was then one of the world's most ambitious ART programs, aimed at providing provide ART to 10,000 individuals through 25 treatment centers. This program has since entered a phase of rapid expansion, which raises two crucial questions: Can the country's current infrastructure accommodate such an expansion, and is the concomitant development of an adequate infrastructure possible?

The lack of an adequate infrastructure and limitations in human resources have been cited as major limiting factors in the ART expansion in such countries as Botswana (1,2). How will Nigeria fare, especially given the fact that, in 2000, the World Health Organization ranked Nigeria's health care system as one of the worst in the world (3)?

Through our work with the AIDS Prevention Initiative in Nigeria (APIN) since 2001 and the President's Emergency Plan for AIDS Relief (PEPFAR) grant based at Harvard since 2004, we have contributed to the upgrading of several health facilities across Nigeria and evaluated many others.

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Based on our firsthand observations and available documents, we will describe and critique the infrastructures for HIV/AIDS control in Nigeria, particularly the biomedical infrastructures. We will examine the constraints on those infrastructures and the ability of existing infrastructures to meet current and future needs. We will also analyze the Nigerian experience in the context of the current ART expansion and try to chart the way forward.

HIV AND THE NIGERIAN HEALTH CARE SYSTEM

Nigeria, like many countries, initially regarded the HIV/AIDS epidemic as a health issue. In 1987, a year after the first AIDS case was reported in Nigeria, the National AIDS/STDs Control Program (NASCP) was created under the auspices of the Federal Ministry of Health (FMOH). At the time, though, the country was suffering from a lack of democracy, accountability, and transparency. During the political and social instability, most health infrastructures were neglected. Scant resources and the lack of political will—compounded by the international community’s political and economic ostracism of Nigeria—limited the potential impact any program could have on HIV/AIDS control.

Nigeria’s return to a democratically elected government in 1999 brought the country’s first signs of a coordinated national response to the growing epidemic. In April 2001, President Olusegun Obasanjo put his political weight behind the fight against AIDS in Africa by inviting African heads of state to attend the African Summit on HIV/AIDS, Tuberculosis, and Other Related Infectious Diseases, the first of its kind in Africa. The implications of this political statement were enormous, and Nigeria has since made significant strides toward the development of adequate infrastructures and institutions for controlling the epidemic.

The FMOH takes primary responsibility for responding to health issues in the country. The HIV/AIDS efforts of the FMOH are conducted through NASCP, working in line with the state ministries of health, HIV and other sexually transmitted infection (STI) programs, and local government authority AIDS action managers. NASCP coordinates national programs that are implemented by federal and parastatal institutions across the country or by institutions at the state or local government level.

In the public sector, treatment and care for HIV rely primarily on the public health delivery system. Nigeria has a three-tiered health care delivery system: primary health care; secondary health care; and tertiary health care. The tertiary health care centers, which consist of the university teaching hospitals and the federal medical centers, are evenly distributed across all the 36 states and the Federal Capital Territory. The general hospitals and state hospitals make up the secondary tier, with each state having at least one hospital, along with one or more branches spread across the state. The primary health care centers, which are the first line of access to health care delivery, are located in local government areas.

The three-tiered system of health care is sometimes a mixed blessing, as different political and administrative structures have authority and control over each tier of the system. The failings of institutions at one tier can place undue strain on the other tiers without the possibility for these levels of government

to remediate the failings of the troubled institution. Instances of duplication and even competition between institutions at different tiers have also been noted.

Other governmental institutions that do not belong to the general health care delivery system remain integral parts of the HIV/AIDS care and treatment delivery. These FMOH-affiliated parastatal institutions include the Nigerian Institute of Medical Research, the Nigerian Institute of Pharmaceutical Research and Development, and public and government hospitals. These hospitals include all military hospitals, police hospitals, and hospitals owned by such government agencies as the Nigerian National Petroleum Corporation, the Nigerian Railways, the Nigerian Ports Authority, the Central Bank of Nigeria, and the Nigerian Prison Services.

Complementing the government health institutions are private-sector hospitals and clinics, including for-profit clinics, which tend to be smaller operations in larger cities. Nigeria’s private-health sector is not well regulated, and few data are available on the extent to which private practitioners are involved in HIV care and treatment (4). A number of large firms, such as the major oil companies, and missionary groups also run clinics and hospitals (4). Many of these clinics and hospitals work with community-based organizations and faith-based organizations to conduct AIDS support services in communities across the country.

Governmental agencies at the federal, state, and local levels tend to suffer significantly from inadequate resources. Despite a formal organizational structure of the various health infrastructures in Nigeria, the health referral system is simply non-operational. Many disparities exist between structures at the same levels. Federal institutions, for example, vary widely in their ability to provide comprehensive HIV services. At the primary health care level, HIV services, when available, are often limited to HIV testing and, in few pilot sites, prevention of mother-to-child transmission services. Most HIV-related services are performed at secondary state hospitals or even only in tertiary centers, such as teaching hospitals and federal medical centers. With the recent paradigm shift resulting from the introduction of ART, the medical aspects of HIV have been addressed after many years of neglect and hopelessness. When the federal government’s ambitious ART program effectively started in 2002, it reached its goals rapidly given the immense latent need for ART. The federal government is spearheading the current rapid expansion with funding from bilateral and multilateral cooperation, including the PEPFAR program, and implementation by Nigerian institutions, both public and private, in cooperation with external implementation partners.

THE INFRASTRUCTURE FOR HIV CARE AND TREATMENT

In the current context of ART provision, HIV/AIDS is viewed as a chronic disease, and most people receive treatment in clinics on an outpatient basis. This is not to suggest that AIDS is not burdening admissions facilities; in some instances, people living with HIV/AIDS account for the majority of admitted patients in some wards.

The Clinical Setting

Although outpatient HIV clinics follow several modalities, most HIV-infected patients attend clinics in which physicians and nurses who specialize in HIV/AIDS treat HIV-infected patients exclusively. The two most common modalities consist of the HIV clinic with a devoted building, such as at University College Hospital in Ibadan and Jos University Teaching Hospital, and an HIV clinic in a more general outpatient facility with devoted time for HIV patients as seen at the University of Maiduguri Teaching Hospital and Lagos University Teaching Hospital.

In the institutions we have visited, facilities dedicated to HIV/AIDS care—often with an attached pharmacy, record office, and laboratories—seem to be better at delivering appropriate care and ensuring patient retention than facilities with no particular specialty. The specialized facilities also have the advantage of not taking away consulting slots from other hospital departments. The main drawbacks are the costs associated with creating a specialized structure, the stigma attached to a building or part of a building devoted entirely to HIV care, and, in the long run, the non-integration of HIV services into the routine services provided by the facility at large.

APIN and more recently the Harvard PEPFAR program in Nigeria have helped several institutions organize and equip their outpatient service facilities for HIV care and treatment. These institutions tend to favor specialized structures for HIV care in an effort to allow a significant expansion of the services provided.

Pharmacies

Pharmacies in federal hospitals are generally large facilities with much more space than the existing stocks require. These pharmacies are staffed by several pharmacists with adequate general training but often limited knowledge of the issues relating to ART. A system of stock management is operated with the use of bin cards. When computers exist, they are usually not used for record keeping and stock maintenance. Refrigeration and a stable supply of electricity continue to be critical issues. In the six sites where the Harvard PEPFAR program is operational—University College Hospital, Jos University Teaching Hospital, Lagos University Teaching Hospital, the University of Maiduguri Teaching Hospital, the Nigerian Institute of Medical Research, and the 68 Nigerian Army Reference Hospital—the pharmacies have been significantly upgraded with the provision of dedicated emergency power generators, operational computerized information systems, refrigerators, and increased security to prevent break-ins.

Laboratories

The laboratory infrastructure is the most expensive and specialized part of any institutional framework for HIV/AIDS care (5,6). In Nigeria, policymakers and decision makers have tended to view laboratories in the narrow context of HIV screening. Over the years, many laboratories across the country were equipped with necessary HIV screening tools, such as equipment for performing ELISA assays. Once rapid tests requiring no specialized instruments were adopted, though, the perceived needs of

infrastructure development contracted even further. Until recently, this development tended to be limited to training sessions for personnel conducting rapid tests in nearly empty, dilapidated laboratories.

At the onset of the ART program no laboratory in the country had the full capacity needed to monitor treatment response and toxicity properly. Only a handful of institutions had the capacity to perform CD4+ counts, a necessary test for decision-making in HIV therapy. The federal government program provided the training and technical capacity for CD4+ tests to be performed in the 25 treatment centers using a manual microscopic technique. This technology is labor intensive, and one laboratory technician cannot reliably perform more than 10 tests a day. This pace cannot accommodate the expansion of ART in these centers and in other centers that would rely on them for laboratory support.

Through a generous donation from MTN Nigeria, a telecommunications company, APIN was able to equip two federal treatment centers—at University College Hospital and Jos University Teaching Hospital—with flow-cytometry-based instruments (7), which allow technicians to process more than 100 CD4+ tests daily. The instruments cut the cost of the tests four- to fivefold. All Harvard PEPFAR program sites are now equipped with these instruments. Many other programs in Nigeria, particularly the other PEPFAR programs, have opted for that investment as well.

Similarly, when the ART program started in Nigeria, only one center had the capacity to perform viral load tests routinely; these tests are used to measure the virus level in the blood of infected individuals and thereby allow clinicians to assess treatment efficacy. This center, the Nigerian Institute of Medical Research, had been upgraded and equipped by a grant from the Ford Foundation.

APIN, a project based at the Harvard School of Public Health (HSPH) and sponsored by the Bill & Melinda Gates Foundation, has significantly affected the level of infrastructures available in its four target states of Borno, Lagos, Oyo, and Plateau. All APIN sites now routinely perform HIV viral load tests with technical assistance and/or equipment provided by HSPH.

When HSPH became a PEPFAR implementation partner, it further expanded the capacity of its collaborating centers. HSPH has provided training and retraining of health professional and laboratory personnel and helped upgrade or establish six laboratories for HIV and STI services. To our knowledge these sites—University College Hospital, Jos University Teaching Hospital, University of Maiduguri Teaching Hospital, Lagos University Teaching Hospital, Nigerian Institute of Medical Research, and 68 Nigerian Army Reference Hospital—are the only public institutions in the country to provide a complete laboratory monitoring of ART response and toxicity by providing serodiagnosis with Western-blot confirmation, hematology, chemical pathology, flow-cytometry-based CD4+ determination, and viral load on a routine basis for nearly all their patients.

In addition, five of these centers are Nigeria's only facilities to perform infant diagnostics using polymerase chain reaction (PCR), the only technique capable of diagnosing HIV infection in infants. In addition, most sites have been involved in projects in collaboration with HSPH to conduct surveillance studies of the HIV strains circulating in Nigeria and of the drug resistance levels in various patient populations.

Additional efforts by the federal government, some state governments, HSPH, other PEPFAR implementation partners, and several international development partners are rapidly changing the face of

Nigeria's biomedical infrastructures. Laboratories that support prevention and treatment efforts are being upgraded and developed in various parts of the country. Flow-cytometry-based CD4+ determination is becoming more and more available, enabling more accurate and less expensive CD4+ counts. Despite all this progress, the pace of laboratory development cannot keep up with the pace of the increased demand for HIV care and treatment.

One remaining criterion for being able to provide the best quality care available to Nigerians living with HIV/AIDS is the capacity to perform drug-resistance testing. At the programmatic level this testing is desirable to enable periodic assessments of resistance levels, to establish patterns of resistance development in strains circulating in Nigeria, and to provide a tool for evaluating adherence (8–10). These activities are now conducted in partnership with HSPH for sites participating in APIN or the Harvard PEPFAR program.

CONSTRAINTS ON INFRASTRUCTURES FOR HIV/AIDS CONTROL IN NIGERIA

The biomedical infrastructure for HIV/AIDS control in Nigeria faces many major problems. Among the most pressing are an inadequate definition of needs, a lack of sustained commitment and insufficient funds from the government, a lowest-common-denominator effect, inadequate manpower, a weak commitment from development partners, equipment maintenance requirements, the need for quality management and accreditation, and the high costs of treatment-response and toxicity monitoring in ART.

An Inadequate Definition of Needs

The burden of HIV on the Nigerian health care system is generally inferred from surveillance data conducted in various patients groups during biennial national serosurveys and local studies and from the attendance at HIV clinics. The country has no systematic information system, however, that would allow an exact picture of the situation to emerge. Unfortunately, most Nigerian hospitals have a paper-based and often obsolete patient record system. Such systems can be rudimentary, particularly at the state hospital and primary health center levels. In that context, it is not always possible to establish reliable health statistics on HIV. The problem is usually compounded by the lack of proper diagnostics and investigational facilities. The system, as it exists, does not allow a full assessment of the burden that HIV/AIDS poses on the health system. Monitoring of HIV/AIDS-related activity is usually performed in a vertical manner within the boundaries of specific programs such as the government ART program, or through such periodic surveys as the biennial seroprevalence survey.

The lack of reliable systematic data leads to an underestimate of the strain that HIV places on the health system. More importantly, the care and treatment requirements can only be guessed at based on imperfect data and general estimates. As an illustration, we can cite the case of an HIV clinic in a

Nigerian teaching hospital that started with visits in physicians' offices and has since moved to three different locations in four years, each time more than doubling its capacity. The clinic increased its frequency to become daily only to find itself overwhelmed within months of each move. In this particular case, we did not witness an explosion of AIDS cases in the city but rather a latent need that the previous facilities and services had not met. The existence of adequate data to predict the needs and plan for the appropriate infrastructures would have prevented the costly exercise of refurbishing new facilities and moving to clinics that would prove too small too fast.

A Lack of Sustained Commitment and Insufficient Funds from the Government

Nigeria's political history has been characterized by instability, with the attendant consequence of a lack of continuity in government policies and programs. A direct result was a lack of sustainable development in the country's health care delivery system. By the time Nigeria's first AIDS case was reported in 1986, the quality of the existing health care delivery infrastructure and institutions had already declined. The democratic institutions in place since 1999, however, have been able to reverse that trend. Unfortunately, despite the commitment of the government, the extent of the decay is such that the pace of rehabilitation of the health infrastructure is not fast enough for tackling the HIV/AIDS crisis. Fund allocation is also an issue, with each component of the health sector jostling for its share of limited resources. The Nigerian government has begun renovating eight teaching hospitals; to date, two of these hospitals have been renovated and commissioned (11).

A Lowest-Common-Denominator Effect

Nigeria is a large federal country, yet it is still traditionally divided along various geographic, religious, and sociocultural fracture lines. The central government is truly at the center of power as it exerts control over resources and most aspects of policy. In most of its administrative and political decisions, the federal government pays obsessive attention to issues of fairness and balance between states and regions of the country. This has the unintended consequence of stymieing progress, as some infrastructure developments may be regarded negatively if concentrated in a region or a state. Government officials have frowned on some infrastructure upgrades because the upgrades were possible only in few centers, creating the perception of inequality or injustice. This regard for equity risks spreading the limited resources so thin to the point of irrelevance.

Inadequate Manpower

Nigeria is probably the African country that has provided the largest number of physicians and other health professionals to nations in Europe and North America, as well as to other countries that, if not more developed, have at least better wages or living conditions than Nigeria. According to the Association of Nigerian Physicians in the Americas, for example, more than 2,500 physicians born or trained in Nigeria are now working in North America. Despite this brain drain, Nigeria still abounds in

well-trained health professionals, many of whom are underemployed because of the lack of openings in public institutions. Yet another major constraint on infrastructures for HIV/AIDS control in Nigeria, therefore, is inadequate manpower.

The chronic shortage of health care delivery personnel in Nigerian hospitals is especially evident in the AIDS field. The most highly trained HIV/AIDS experts are always in constant demand and working on multiple projects. The Nigerian government, with the assistance of APIN, has developed a basic training curriculum that has been used to educate a large number of health professionals across the country. Yet with the advent of ART, HIV medicine and laboratory sciences have become fields of high specialization that require advance training that is currently only available through apprenticeship. No Nigerian university has established HIV/AIDS as a field of study. It will be difficult to develop good infrastructural capacities for HIV/AIDS control and upgrade existing ones if there are insufficient numbers of well-trained personnel to run these facilities.

Most of the infrastructures for HIV/AIDS control in Nigeria are plagued with a shortage of competent professionals, and institutions that are well staffed usually find it difficult to retain their staff. Similarly, institutions have not established strategies and policies for retaining personnel with specialized HIV training. For instance, nurses and counselors who received HIV-specific training are sometimes redeployed in another position, often within the same institution, where their recently acquired skills are not applied.

A Weak Commitment from Development Partners

The policies of many international development partners play an unintended role in the problem of inadequate manpower in Nigeria. Most agencies involved in HIV/AIDS prevention and control efforts in Nigeria are goal driven, and an enormous pressure is placed on them to show results within a specific timeframe. Instead of training new personnel or building new infrastructures, many of these agencies engage the services of a few highly skilled professionals, while others rely on the expertise of experienced personnel from abroad. This has in no small measure contributed to the shortfall in the development of infrastructures for HIV/AIDS control.

Furthermore, donor agencies usually fund projects on a two-to-five-year basis to meet short-term goals; such a timeframe often is not enough to build a sustainable infrastructural capacity — nor is that capacity ordinarily part of the funder's indicators of success. In addition, many international partners tend to circumvent paralyzing government bureaucracies by administering programs themselves in an effort to save time and be more efficient. The net effect is the tendency toward multiple, semi-autonomous, overlapping projects clustered in some regions of the country. Local expertise is often diverted onto the projects, creating vacancies in other areas. Once a project has been completed, however, personnel and equipment are often dispersed, creating no lasting impact on infrastructural development.

Equipment Maintenance Requirements

Modern laboratories charged with the follow-up of ART patients — such as the ones developed by APIN and the Harvard PEPFAR program — represent significant investments in equipment. The average cost of equipping a complete laboratory — one that can perform high-volume hematology, chemical pathology, flow-cytometry-based CD4+ determination, viral load, and DNA PCR — approaches US\$300,000. Such an investment needs to be protected by having in place plans that allow preventive maintenance and timely emergency repairs. As often as possible, equipment and automated systems provided by companies that offer technical support and maintain a representative in Nigeria should be selected. Given the poor quality of the power supply, surge protectors must be installed on all expensive or crucial pieces of equipment. Unfortunately, for many instruments the technical competence for maintenance and repair is not available in the country. As the infrastructure system develops the need for training will grow even more urgent.

Quality Management and Accreditation

Nigeria has no functioning laboratory accreditation system. Quality assurance and quality control were foreign concepts to most of the laboratories we visited, and not a single laboratory had a quality-management plan. No segment of the health system, in fact, seems to have a quality-management plan. There is a need for laboratory system specialists trained in quality management. The Standards Organisation of Nigeria, a member of the International Organisation for Standardisation, does not have health-related industries or institutions certified, with the exception of three pharmaceutical manufacturers and distributors. APIN has instituted a limited system of quality assurance and control for the laboratories affiliated with the project, and a significant strengthening of this system is under way through the Harvard PEPFAR program.

Costs of Treatment Response and Toxicity Monitoring in ART

In recent years there has been a growing advocacy effort around the globe for access to ART in resource-constrained countries (12). This has led to significantly reduced prices for drugs and the development of many generic versions and new formulations. Unfortunately, the global community at large did not show the same level of effort for advocacy for laboratory monitoring of the treatment (5,6). This is not to say that prices have not dropped. In recent years we have witnessed a more than threefold decrease in the price of reagents for viral load for most resource-constrained countries. Prices of CD4+ assays have also fallen, and less expensive alternatives have been developed. Yet laboratory monitoring — including the cost of reagents and the associated cost of supplies, personnel, and infrastructure buildup and maintenance — accounts for a sizable portion of the cost of maintaining an individual on ART.

For instance, the government of Nigeria has been subsidizing drugs for ART without a similar effort toward treatment monitoring, resulting in a situation in which most patients were being treated without proper monitoring. It has been estimated that treatment monitoring would account for 23% of the total cost of treatment and one-half to two-thirds of patients' out-of-pocket expenses (13). The estab-

lishment of the Harvard PEPFAR program has helped alleviate this problem in areas in which the program is operating, but the problem remains acute in other areas.

CONCLUSION: THE WAY FORWARD

Nigeria, whose population represents 20% to 25% of those living in Africa, faces enormous challenges with the HIV/AIDS epidemic. Although no other African nation has had an experience directly applicable to Nigeria as a whole, two countries—Botswana and Senegal—offer relevant lessons from their experience with building ART programs (2,14).

Botswana, a sparsely populated country on a large landmass, has high prevalence rates of HIV infection. The country's ART program started in the capital, Gaborone, and rapidly expanded to most areas of the country without the development of sophisticated infrastructures. The program operated with referral of blood samples for monitoring tests to a central laboratory in Gaborone. Later, a second laboratory opened in the second largest city. The main emphasis in rolling out the ART program has been on training; Botswana has developed an exemplary training curriculum for health care workers, which has since served as a model for many countries, including Nigeria (2). Serious concerns have arisen, however, about the ability of the central laboratory to cope with the volume of test requests and the ability of the program to be monitored and evaluated properly. The Harvard PEPFAR program in Botswana is helping the Botswana government in bolstering its monitoring and evaluation capacities.

Senegal, in contrast, is a smaller country with a larger population and a low HIV prevalence rate. The government ART program, one of the first in Africa, began in the capital, Dakar, and was later rolled out to the various regional capitals of the country only when the adequate infrastructures were in place. Although the delay in the roll out dampened the success of the initial start of the program, it ensured that patients were provided adequate care and that the program was monitored properly.

In Nigeria, the ART program was started without addressing most of the country's infrastructure issues. The recent involvement of such projects as APIN and such programs such as the Harvard PEPFAR has been changing the picture significantly. Infrastructures are being developed in many cities around the country. Several key elements still need to be addressed, however, to prevent future problems:

- Government decision makers, the donor community, and implementing partners must demonstrate a strong and sustained commitment to infrastructure rehabilitation in particular laboratories.
- The country has an urgent need to improve not only its health and HIV data collection and analysis, but also its epidemiologic research to be able to properly define the needs of each town, city, state, and region of the country. The development of appropriate infrastructures is contingent on the definition of the needs in matters of care and treatment of HIV.
- Training of more HIV specialists must take priority. The government is conducting training programs to update health professionals, but the pace must be accelerated. Universities should not only reinforce HIV in curriculums, but also develop an HIV specialization in all aspects of social and biomedical sciences as well as medicine.

- Health institutions involved in HIV care and treatment must develop flexible and efficient horizontal networking to be able to address the needs of patients. The agility of such a system requires that the networks be organized on objectively defined and practical parameters that would not impede their functioning.
- Vertical networking must also be reestablished to allow the secondary and primary health care systems to fulfill their roles and alleviate the burden on the tertiary institutions. At present, ART centers are not only treating patients who need ART, but are also monitoring thousands of otherwise healthy individuals infected with HIV and patients on ART who are stable. The system could become more efficient if this monitoring role could be devolved to the lower tiers of the health system. It would be unrealistic to wait for the full repair of the Nigerian health care system, but it can be conceived of a system in which tertiary centers would partner with secondary or primary health centers. Some centers would refer patients to other centers for follow-up and in exchange provide training and other technical support.
- Several reference centers that would operate with the most modern techniques are required, not only to serve as referral points for difficult cases but also to conduct clinical and operational research in treatment and care of HIV. Continuous research is necessary to develop evidence-based solutions to the problems that need to be tackled. A lack of commitment to research is a serious impediment to developing appropriate solutions to the various problems the ART programs face in many African countries. Often the emergency of the situation requires that solutions be found in the experience of another country. In general, though, the balance must be struck between reinventing the wheel and taking a one-size-fits-all approach. These centers would be ideal sites for developing quality control systems for other laboratories.
- Nigerian institutions and their implementing partners should harmonize their various technical platforms for four reasons: to ensure that results are comparable from one center to another; to facilitate the contracting of any maintenance needs outside of Nigeria; to be able to buy reagents and other consumables from a single manufacturer in bulk, thereby reducing costs and increasing the likelihood of sustainability; and to facilitate the implementation of quality assurance and control measures.

To contain its HIV/AIDS epidemic effectively, Nigeria must pay much more attention to developing its infrastructural capacity by strengthening institutions and enhancing the training of health care delivery personnel in the area of HIV. Although the best way to approach these goals has been the subject of much debate, experts seem to agree that decision makers in Nigeria must significantly increase their commitment toward building new infrastructures and upgrading or maintaining existing ones. Nigerian institutions have tended to rely on the help of international development partners. Yet to attract the necessary funding and technical expertise, they should first demonstrate a strong commitment and a clear expression of infrastructural development needs.

Overcoming the constraints will not be easy. In recent years, though, one of the best approaches for Nigerian tertiary institutions has been to establish collaborations with international institutions and organizations in all areas relevant to HIV control. The need to strengthen Nigerian biomedical institutions is critical, and collaboration with international institutions, if built on a well-defined intervention and research agenda, can help strengthen capacity significantly by offering long-term partnerships. Large multilateral and bilateral efforts at the government level are rarely amenable to the in-depth partnership required to uplift existing institutions. They are, however, necessary for the establishment of new large institutions. We are already witnessing positive developments in the direction of institutional partnerships. Since 2001 HSPH has forged collaborations with six Nigerian institutions through APIN and more recently the Harvard PEPFAR program. Other public and private institutions—including the University of Maryland, Johns Hopkins University, Family Health International, and the U.S. Centers for Disease Control and Prevention—are involved in various direct collaborations with different Nigerian institutions as well.

The federal government of Nigeria must provide an enabling environment that will encourage international developmental agencies to embark on long-term projects that incorporate funding for local infrastructural development. There is also a need for greater cooperation between policy makers and researchers to increase the indigenous capacity to conduct research and promote the use of research results in formulating policies. Research is needed to define the monitoring strategies that afford the greatest attainable care to patients with HIV while taking into account the limitations of the resource-poor setting. Research results—when incorporated into the policy and strategies design and health programs implementation at all levels of the country's health system—will go a long way toward helping planners and policy makers develop effective long-term infrastructural development objectives.

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