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THE CORNELL-BAHIA PROGRAM, 1975-1978: DEVELOPMENT OF A TROPICAL COMMUNICABLE DISEASES LABORATORY CENTER[1, 2]

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In 1975 Cornell University Medical College, the Federal University of Bahia, and the state of Bahia initiated a cooperative international program to develop a center for the study and control of communicable diseases in northeastern Brazil. This article provides a preliminary assessment of that program.

Introduction

The objectives of the Cornell-Bahia program were to develop a reference laboratory that would support the local health facilities, to provide laboratory support for community public health programs, to train Brazilian personnel in clinical microbiology, and to develop links between the laboratory and the University of Bahia. This program evolved from a previous collaborative program of training and research undertaken by Cornell University Medical College and the University of Bahia *(1)*. In addition to these institutional ties, the University of Bahia was geographically well-suited to be the site for a tropical communicable diseases center. Many of the world's major communicable diseases (including schistosomiasis, leprosy, leishmaniasis, typhoid fever, Chagas' disease, hepatitis, poliomyelitis, diphtheria, tuberculosis, and leptospirosis) are prevalent within the state of Bahia. Furthermore, the state capital of Salvador (located on a peninsula just south of the equator) is an important population center currently suffering from the burdens of rapid growth. Salvador's population (now over 1.3 million) has tripled in the past 25 years; and although the city has many features of a metropolitan center, half of its economically active population is underemployed or unemployed *(2)*.

The site chosen for the communicable diseases center was the state's Gonçalo Moniz Foundation in Salvador, a laboratory center established in 1915 that had a long tradition of research and service *(3)*. A University of Bahia faculty member (AGB) was appointed director of the laboratory and coordinator of the program for the university and Bahia State. A Cornell faculty member was appointed to coordinate that university's contribution to the program.

The state of Bahia and the Federal Ministry of Health allocated funds for building construction and renovation as well as for purchase of equipment available in Brazil. Cornell University received a grant from The Rockefeller Foundation for the purchase of imported equipment, travel, books and journals, and laboratory supplies. The sources of funding and the disbursements made in the three-year period 1975-1978 are shown in Table 1.

The renovation of the laboratory buildings, which took a year, was largely completed when the first Cornell faculty members arrived to work there in 1977. A major problem was en-

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Table 1. Sources of funds for the communicable diseases center and its disbursements, 1975-1978. The sums cited are approximate because of fluctuations in the cruzeiro-dollar exchange rate.

Disbursements (in US$) for	Sources of funds			
	Bahia State	Brazil (federal government)	University of Bahia	Rockefeller Foundation
Personnel	$337,493		$50,278	$44,325[a]
Supplies and equipment	322,714	$57,003	105,000[b]	22,637
Renovation and construction	332,342			
Transportation				27,303[c]
Housing and per diem allowances				28,918[d]
Miscellaneous expenses				5,633
Total	$992,549	$57,003	$155,278	$128,816

[a]An additional $75,000 was provided by The Rockefeller Foundation for fellowship stipends.
[b]These funds were provided to the University of Bahia by The Rockefeller Foundation.
[c]These expenses included purchase and maintenance of a vehicle in Bahia and air travel by Cornell and University of Bahia personnel.
[d]These expenses included furnishing and maintenance of an apartment for Cornell personnel in Bahia.

countered, however, because the buildings had been improperly wired. A second electrical renovation project, requiring 16 months, was finally completed in April 1978. Although several projects could not be initiated in the interim as a result, the laboratory nevertheless functioned reasonably well during this period—due largely to the ingenuity of several foreign and local staff members and a considerable amount of Brazilian *"jeito,"* which loosely translated means "a way" *(4)*.

Another problem was posed by the need to establish reliable supply lines. Routine laboratory supplies ordered through the state took at least six months to arrive. The practical solution of this problem was creation of a stock-room system. Nonetheless, it was still necessary to order approximately 20 per cent of the supplies through Cornell University and hand-carry these items to Brazil. Direct shipment of items from the United States was made impractical by the long delay required for government import permits.

Training Programs

The training of laboratory technicians and other health professionals was given the highest priority after laboratory renovations were completed. In Brazil, technical personnel receive their training in university schools of pharmacy. Their curriculum is didactic, and there are no licensing examinations. It was therefore necessary to create new courses that stressed laboratory methods and the fundamentals of clinical microbiology.

The Cornell faculty members utilized their expertise in immunology and microbiology to design such courses. The first students were technicians employed by the state; but as Table 2 indicates, subsequent courses were offered to nurses, rural health workers, medical students, and physicians. These "students" came from the University of Bahia and other institutions in the state, as well as from the states of Paraíba, Sergipe, Piauí, Alagoas, and the Federal District (Brasília). The courses were taught by faculty members of the universities of Bahia, São Paulo, Rio de Janeiro, and Cornell; and a mycology course was given by a consultant from the U.S. Centers for Disease Control (Atlanta, Georgia). Manuals from the Centers for Disease Control *(5-7)*, Mayo Clinic, University of Washington, and Cornell University were translated into Por-

Table 2. Biomedical courses offered by the communicable diseases center in 1977-1978.

Course title	Type of sessions		Times offered	Duration of course		Course participants from Bahia (total)				
	Lecture	Laboratory		Weeks	Hours per week	Physicians	Nurses	Medical students	Laboratory technicians	Rural health workers
Clinical microbiology[a]	X		5	2	20	33		25	60	
Basic laboratory fundamentals of microbiology	X	X	2	16	40					27
Advanced laboratory fundamentals of microbiology		X	1	12	20				96	
Advanced public health[a]	X		2	20	40	12	30		32	
Clinical mycology	X	X	1	4	20	1		1	5	
Basic immunology	X	X	2	4	20	5			4	
Total						51	30	26	197	27

[a]These courses also included students from the states of Paraíba, Sergipe, Piauí, Alagoas, and the Federal District (Brasília)

tuguese and modified for these courses. The duration of the six courses offered ranged from two to 20 weeks; most of the courses were offered more than once (see Table 2). The total number of students participating in these courses during 1977 and 1978 was 331.

Special fellowships for training outside Bahia were also obtained. Specifically, six technicians received six-month fellowships from the Brazilian Government for laboratory training at the Adolpho Lutz Institute in São Paulo. The Rockefeller Foundation also provided fellowships (lasting 18 to 24 months) that enabled three Brazilian physicians to receive training in clinical microbiology and immunology at New York Hospital and Cornell University Medical College.

Clinical Laboratory Services

The state of Bahia had maintained a clinical microbiology laboratory for many years. However, the laboratory had not been very active in recent times because of funding problems and a general lack of interest. As a result it performed only a few procedures, received few specimens, lacked quality-control programs, and did not employ the most modern and reliable methods. The major sources of specimens were city and state hospitals and clinics that lacked microbiology laboratories of their own.

Our immediate goal was to upgrade the tests being offered, provide quality control for them, and then introduce new procedures in conjunction with our training programs. In addition, there was a need to perform a number of basic tests that were not then being offered by any laboratories in the state, and to carry out other tests that were only being performed by certain private laboratories at a cost prohibitive for most patients.

Internal quality control was required because external controls were not available in Brazil. In this regard, a number of simple but fundamental measures were found to have a major impact on the reliability of existing procedures. Several of these measures and the problems that they helped resolve are listed in Table 3.

For example, the laboratory rarely isolated group A beta-hemolytic streptococci from throat cultures because it utilized glucose-containing media that inhibits hemolysis. The deletion of glucose from the media resulted in a marked increase in the number of cultures reported positive.

Perhaps the value of quality control was best demonstrated by the review and revision of procedures used for determining the virulence of *Corynebacterium diphtheriae* isolates. The laboratory processed 700 to 900 cultures per year for *C. diphtheriae,* of which 11 per cent were found positive. However, before 1977

Table 3. A number of initial problems affecting the quality of laboratory tests and measures taken to resolve them.

Problem	Solution
1) Irregular electrical supply to refrigerators and incubators	Daily temperature checked and emergency generator installed
2) Contaminated media	Autoclave function tested; sterile technique reviewed; media room remodeled
3) False identification of enteric bacteria	Positive and negative controls utilized
4) Antibiograms unreliable	Only antibiotic disks of known concentration used; strict Kirby-Bauer technique employed
5) Group A streptococci not isolated	Media changed from glucose-containing to glucose-free
6) Protozoan cultures frequently contaminated	Fresh antibiotic solutions used
7) Mold on microscope lenses	Plastic boxes containing silica gel dessicant constructed to house microscopes

none of the isolates had been found virulent by toxigenicity testing, and so epidemiologic investigations of families and contacts had not been carried out. In 1977 the virulence testing procedure was modified, with positive and negative controls being employed *(8, 9)*. Subsequently, 10 per cent of all the *C. diphtheriae* isolates were shown to be toxigenic. These data prompted the epidemiologic section of the state health department to expand its immunization and surveillance programs. A number of other tests were similarly upgraded so that reliable results were obtained (Table 4).

As Table 4 also shows, altogether new procedures and tests were introduced. One example of these was the FTA-ABS test to confirm a diagnosis of syphilis. This test was negative in 9 per cent of the 355 patients with positive venereal disease research laboratory (VDRL) findings in 1978. This high incidence of false-positive VDRL findings was due, in part, to other infectious diseases in Bahia such as leprosy, malaria, and Chagas' disease.

The indirect hemagglutination (IH) and fluorescent antibody (FA) tests for Chagas' disease were also introduced in 1978. The laboratory had previously relied on the complement fixation (CF) test, which lacks sensitivity and specificity *(10, 11)*. Of these tests for Chagas' disease the FA test yields the quickest positive results; it also remains positive longer than either of the other tests *(12, 13)*. The major advantages of the IH test are its simplicity and its value in screening large numbers of sera. The procedure now followed in the laboratory is to perform both the CF and IH tests on all test sera and, if only one of these two is positive, to confirm the diagnosis with an FA test *(12)*. The FA test is not performed if both the IH and CF tests are positive. This procedure provides maximum sensitivity and specificity despite known cross-reactions between trypanosomal and leishmanial antigens.

During a five-month period, tests for Chagas' disease were performed on sera from 435 asymptomatic subjects as part of routine preemployment examinations. The CF and IH tests were not in agreement regarding 43 patients, only one of the two tests yielding a positive result in each case. Using the FA test to obtain a definitive diagnosis in these 43 cases, it was determined that the CF test had produced seven false-positive and four false-negative results, while the IH test had produced nine false-positive and 23 false-negative results. The significant percentage of false-positive tests was of particular concern because a serologic diagnosis of Chagas' disease, even in the absence of clinical illness, makes a person ineligible for many job opportunities in Bahia.

As Table 4 shows, other laboratory examinations introduced included serologic tests for leptospirosis, toxoplasmosis, poliomyelitis, and rubella. Also, bacteriologic culture proce-

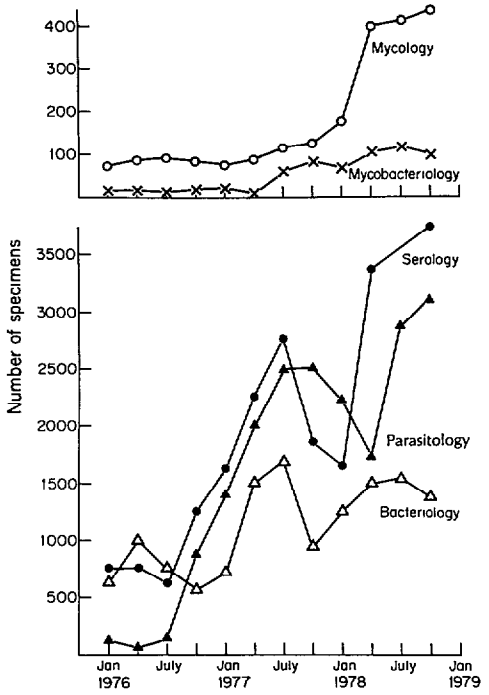
Table 4. The availability and reliability of tests at the communicable diseases center. R = reliable; U = available but unreliable; – = not available.

Test	Year		
	1976	1977	1978
Serologic tests:			
Chagas' disease tests: complement fixation	U	R	R
hemagglutination	–	–	R
immunofluorescence	–	–	R
VDRL	–	R	R
FTA-ABS (syphilis)	–	–	R
Pregnancy test	–	R	R
Antistreptolysin O	R	R	R
Rheumatoid factor	R	R	R
Widel H and O agglutinins	R	R	R
Paul Bunnell heterophile	R	R	R
C-reactive protein	R	R	R
Toxoplasma IFA	–	–	R
Leptospira agglutination	–	–	R
Polio complement fixation	–	–	R
Rubella IHA	–	–	R
Hepatitis antigen	–	–	R
Bacteriologic tests:			
Blood culture	U	R	R
Urine culture (quantitative)	U	R	R
Stool culture	U	R	R
Throat culture	U	R	R
Cultures of water (coliform and cholera)	R	R	R
Gonococcal cultures	–	–	R
Antibiograms	U	U	R
Acid-fast smears *(M. tuberculosis)*	R	R	R
Culture and sensitivity of *M. tuberculosis*	–	–	R
Virologic tests:			
Enterovirus cultures (polio)	–	–	R
Mycologic tests:			
Dermatophytes	R	R	R
Deep mycoses	–	–	R
Protozoan and helminth tests:			
Stool O and P	R	R	R
E. histolytica cultures	–	–	R
Trichomonas wet mounts and cultures	–	R	R
Blood and marrow smears and cultures for protozoa	–	R	R

dures were improved and culture media for *M. tuberculosis* and *N. gonorrhoeae* were made available. (Using the latter media, over a four-month period 16 per cent of 256 gonococcal cultures from two health clinics were found positive. The patients were predominantly female, and 90 per cent of the infected patients were asymptomatic.) In addition, the laboratory now has the capability to culture enteroviruses, *E. histolytica,* and fungi causing systemic disease. The medical community's confidence in the services provided and willingness to use the new examinations introduced have been reflected in a marked increase in the number of specimens submitted to the laboratory (see Figure 1). Indeed, the number of specimens received per quarter increased 5.3 times between July 1976 and July 1978.

The communicable diseases center has also provided support for several major public health programs. Specifically, the laboratory has performed over 13,000 serologic screening tests for Chagas' disease as part of a government epidemiologic survey. In addition, it has provided support for clinical studies of diarrheal illness, including a search for the enteric pathogen *Vibrio parahaemolyticus (14).* It has also employed counterimmunoelectrophoresis

Figure 1. Changes in the number of clinical specimens received by the communicable diseases center, January 1976-January 1979.



to detect bacterial antigens in spinal fluid, a procedure of value in providing specific etiologic diagnoses for partially treated meningitis patients.

During 1979, studies on the epidemiology, pathogenesis, and immunology of Chagas' disease, leprosy, and leishmaniasis have also been initiated. This research program, which is multidisciplinary, involves investigators from the University of Bahia, Cornell University, and Rockefeller University. The resulting collaborative effort, planned as a long-term program, is expected to yield new insights into these major diseases.

Discussion

The communicable diseases laboratory center in Salvador, Brazil, now serves as a reference laboratory for the entire state of Bahia and provides support for community public health programs. The prerequisites for successful development of such a facility include recognition of need, administrative cooperation, affiliation with universities or other sources of expertise, and patience in dealing with unavoidable problems and delays.

The need for a reliable microbiologic laboratory has been recognized for many years by the academic, clinical, and administrative leaders in Bahia. Despite the importance of communicable diseases, however, the development of clinical microbiology has lagged behind that of clinical chemistry and hematology. The state of Bahia is not unique in this regard. Carvalho *(15, 16)* recently assessed the general status of public health laboratories in Brazil and made the following observations: (1) less than a third of the states in Brazil have even minimally adequate central laboratory facilities; (2) the existing laboratories lack basic equipment and trained personnel; (3) the microbiology and communicable disease services stand in greatest need of development; (4) regional laboratory networks have been absent or have lacked adequate communications and specimen transport methods.

Our immediate goal of developing a central laboratory facility with a trained staff and adequate equipment has been realized. Efforts are now underway to expand and upgrade the laboratory network throughout the state. Personnel to staff these facilities are being trained, and transport systems for microbiologic materials have been developed *(17)*.

The development of the laboratory was facilitated by the support given the project by senior officials of the state government and the University of Bahia. These people were interested and accessible, and they implemented the recommendations made by participating consultants.

It is also true that many unanticipated problems were encountered. Some of these stemmed from a shortage of trained supervisory personnel and the absence of laboratory models in the area that could be emulated. Adequate communications and supply channels were eventually established by under-

standing the Brazilian system, enlisting the cooperation of many people, and relying on the concept of *jeito (4)* as a last resort.

The laboratory's university affiliation was essential to its development. The university is usually the only source of expertise available, and it also provides an invaluable stimulus to achieve excellence. (In cases such as this the prestige of a university affiliation tends to be very important for the new facility.) The university also added a new dimension to the laboratory by providing opportunities for collaborative scientific studies; and the laboratory, in turn, provided the university with research facilities and clinical material relevant to the major health problems of the region.

The impact of this program on the study and control of communicable diseases in northeastern Brazil may not be known for many years. However, the program has been sufficiently successful so that in 1979 the emphasis was shifted away from establishment of basic services and toward increased utilization of the laboratory by local and regional health facilities. The quality of available health care has been improved by providing reliable laboratory support; the people trained at the center constitute a valuable resource that should perpetuate itself and grow as they train others; and the laboratory is becoming a research center where both local and foreign scientists can participate. Taken together, the presence of these elements—modern facilities, a trained technical staff, and collaborating local and foreign scientists—operating in a region where many of the world's major communicable diseases are prevalent is providing a unique opportunity to increase our understanding of those diseases.

SUMMARY

In 1975 Cornell University Medical College, the Federal University of Bahia, and the state of Bahia undertook a cooperative international program to develop a center for the study and control of communicable diseases in northeastern Brazil. Accordingly, they sought to develop a reference laboratory that would support local health facilities, to provide laboratory support for community health programs, to train Brazilian personnel in clinical microbiology, and to develop links between the laboratory and the University of Bahia.

The impact of this program may not be fully known for many years. However, it has succeeded in upgrading laboratory services and providing reliable laboratory support for Bahia; and, as a result, the quality of health care available in Bahia has improved. In addition, the program has trained over 300 medical students, laboratory technicians, rural health workers, nurses, and physicians in clinical microbiology and other biomedical subjects; and the laboratory center it developed is becoming an important research center for both local and foreign scientists. Taken together, these circumstances present a unique opportunity to increase our understanding of major communicable diseases.

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WHO REPORT URGES LARGER HEALTH ROLE IN PLANS FOR DEVELOPMENT

Even though a healthy worker is indispensable to the attainment of economic goals, the role of health is "often under-estimated or ignored by policy-makers."

In a report presented to the U.N. Conference on the Least Developed Countries (LCDs) meeting in Paris on 1-14 September 1981, the World Health Organization made a plea for support of health programs and a larger share of the development dollar.

The population least provided with health services is estimated to be around 200 million out of a total population in the LDCs of 280 million. The infant mortality rate in the 32 LDCs is highest in the world, and the life expectancy lowest.

They are the world's most needy, yet most neglected.

Source. WHO Features No. 72, September 1981.