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Childhood vaccinations are one of the most effective and cost efficient ways of reducing the staggering childhood mortality in Africa. They are both affordable and safe. Yet each year over five million African children will die because, according to Senator Nancy Kassebaum, Chairman of the Foreign Relations Committee on African Affairs, "of the inability or unwillingness to provide each infant with five dollars worth of vaccinations."

To get a picture of infant mortality caused by childhood diseases, visit any maternity clinic in an African country and count the newborns. Two of every ten are likely to die from measles during the next three years. Five in every thousand will die or be crippled from polio. A few infants will die in their first month of life from neonatal tetanus. After counting up all the deaths, only seven of ten infants are likely to survive until their third birthday, an absurdly low survival rate especially when a series of childhood vaccinations can reduce these deaths to near zero.

The vaccines against polio, whooping cough, diphtheria, tetanus, and measles have been available for the last decade, yet effective vaccination programs have not emerged to reduce the childhood

illnesses and deaths caused by these diseases. Recognizing the gap that existed between the improved vaccines available for childhood disease prevention and the lack of effective immunization programs, the World Health Organization General Assembly in 1976 passed a resolution that required all member nations to develop vaccination programs that would immunize 90% of all children against vaccine preventable diseases by 1990. A special Expanded Programme for Immunization Unit (EPI) was set up at WHO headquarters in Geneva to assist member states in achieving this goal.

The EPI Unit assembled a panel of experts to help develop a strategy for action. One of the first observations made by these experts was that control of childhood vaccine preventable diseases was a much different task than the WHO program in the 1960s and 1970s to eradicate smallpox. To control these diseases would require more than the "search and destroy" approach of the smallpox eradication program. An immunization program would require the development of a national plan of operations designed to meet each country's needs. This plan would be a permanent part of the health care system and would assure that each infant would receive childhood immunizations and that these immunization services would continue to be offered infants born in subsequent years.

A continuing program of vaccinations posed new problems. It would no longer be sufficient for a national program to just vaccinate children. An inventory system must be developed to assure that there

are adequate stocks of vaccines and other materials in the country. A continuing education program must assure the training of health personnel in immunization techniques. A distribution system must be established to assure that supplies were available and maintained in each health unit. An evaluation system must be designed to assure that vaccinations are being performed and are effectively reducing infant illness and deaths caused by these illnesses. In short each immunization program would not be merely a public health project, but a management program designed to assure the continuation of these immunizations.

The EPI Unit at WHO headquarters in Geneva began to develop a management approach to solving the problem of establishing effective immunization programs. A series of training courses was developed, in conjunction with the U.S. Public Health Service's Centers for Disease Control that were designed to introduce immunization personnel to basic management techniques. The National EPI Manager Course includes units on program planning, budget preparation, and setting of goals and objectives. The training course for mid-level personnel has sessions entitled, "Evaluation of Vaccination Coverage", "Supervision of Personnel", and "Distributing Resources". To even further emphasize EPI's commitment to management, the head of the EPI Unit in Geneva, Dr. Rafe Henderson, is designated the "Program Manager", rather than Director!

To aid African nations in the development of their immunization

Program management expertise, the U.S. Agency for International Development awarded several "accelerated impact program" grants for expanded immunization programs. These grants included funds for the purchase of certain refrigeration and transportation equipment, and the provision of a technical operations advisor who would be based in the country to provide assistance in developing various management systems. In late 1980, the People's Republic of the Congo received one of these two year \$500,000 grants.

Prior to the USAID assistance, the Congo's immunization program was carried out by several mobile teams that visited various health centers and maternal and infant clinics throughout the country. In the cities of Brazzaville and Pointe Noire, vaccination sessions were scheduled usually once a month. In rural areas these visits were once or twice a year. Mothers forgot the dates when the team would be at the clinics. When they remembered, they were often disappointed when they arrived at the clinics since the teams faced shortages of vaccine, needles, syringes, and even gasoline for their vehicles. This haphazard and poorly organized approach to childhood immunization was even more evident in examining the vaccination coverage and disease statistics. While ninety percent of all infants received their BCG vaccination that is given to protect against tuberculosis at an age less than one month, only forty-five percent of these children returned four months later for their third doses of Diphtheria, Whooping Cough, Tetanus, and Polio vaccines. Clearly another strategy had to be adopted.

Before an immunization program could be developed a complete assesment of the Congolese health system and the disease patterns had to be undertaken. The patterns of the vaccine preventable childhood diseases in the country were analyzed. This epidemiological pattern of diseases proved to be similar to that found in other sub-Saharan countries. These six diseases, tuberculosis, whooping cough, diphtheria, tetanos, polio and measles, usually affected infants between the age of nine months and three years. Measles was especially common every two to three years and frequently appeared in epidemic proportions midway through the heavy rainy season. Half of all cases of lameness in the children was found to be due to poliomyelitis, and interestingly, an additional twenty percent was due to the permanent trauma caused by improperly administered hypodermic injections. Although neonatal tetanos was less common in the cities where most mothers deliver their children in maternity clinics, in the rural areas tetanos was an important cause of neonatal deaths. Although the number of diphtheria cases was not high, the cases of whooping cough was, and they seemed to follow a regular annual pattern.

Next, a complete inventory of the country's health care resources was made. The number of hospitals, clinics, maternities, and health personnel was charted on a map of the country. The demographic pattern of the population distribution was examined. The Congo is, by comparison with other African countries, an urbanized country. Nearly

sixty-five percent of the population lives in the cities of Brazzaville and Pointe Noire or along the heavily populated railroad line that extends between these two cities.

Finally, two major program objectives were developed. These objectives, subject to future modification, formed the basis for the first National Expanded Immunization Program. They were 1) by 1990, implement an immunization program capable of providing childhood vaccinations to all children born in the Congo, 2) reduce the illness rate (morbidity) and death rate (mortality) of the six childhood diseases by 80 % by 1990. These objectives would be achieved by a series of discrete steps that included training of health personnel, developing a disease surveillance system, organizing a warehousing and inventory system, and lastly the establishment of fixed site vaccination facilities in the urban areas with gradual extension of these services throughout the interior of the country. Because of Congo's urban demographic pattern, over half of the population could be reached by first establishing the program in Brazzaville and Pointe Noire. This urban approach would allow personnel time to gain expertise in management and supervision before extending the program into the rural zones where more difficult logistical and operational problems existed.

Vaccine, refrigerator, and vaccination material needs were carefully calculated based on the urban target population and on the methods taught in the EPI National Manager's Course, and orders for

the first two years of supplies were placed in Europe and the United States. The program manager decided to continue support to the existing mobile teams that provided immunization services in the interior of the country since the EPI did not have enough personnel resources to initiate the program in all areas of the country during the first year. A training course was developed using materials produced by the World Health Organization. All vaccines and supplies were counted and an inventory card established for each item.

The first national mid-level training course was held in September, 1981, four months after the naming of a national program manager and three months after the arrival of the American technical officer, a medical epidemiologist, on loan for two years from the Centers for Disease Control's International Health Program Office. Forty-five participants were selected - one person in each health center in Brazzaville and Pointe Noire and two from each rural health zone. The course was two weeks in duration and included training exercises for planning program activities, conducting vaccination sessions, establishing a stock system, and the evaluation of program effectiveness.

Following the training course, a series of "mini-courses" were conducted at the maternal and infant clinics in Brazzaville. In each clinic a group of five to eight health workers volunteered for the EPI training. Since in each clinic there was one person already trained in the EPI mid-level techniques, she usually became the

clinic immunization team leader. Each of the mini-courses consisted of four ninety minute training sessions. Each session was devoted to an important topic - vaccine preventable diseases, care and storage of vaccines ("cold chain"), management of vaccination sessions, and program administration including record keeping.

After the four sessions, a refrigerator, a small supply of vaccine, needles and syringes, reporting forms, and sterilization equipment was delivered to the clinic, a date was fixed for the first vaccination session, and personnel from the national office of the immunization program were present to assist in the first practical session.

A surveillance system was established to monitor the impact of the vaccination program on the morbidity and mortality of the target diseases in Brazzaville and Pointe Noire. This system compiled clinic and hospital visit data from a sample of health clinics. These clinics were selected from all of the health facilities in the two cities as being most likely to see a child population representative of the entire urban child population. These sample sites, called sentinel sites, would serve as the "early warning system" for disease outbreaks and program successes and would obviate the need to collect disease data from all health facilities. Data was collected on the number of patient visits in each clinic on a weekly basis and charted on a graph. This graph, when compared to with previous years' data, gave the project of the current state of the childhood diseases in the two cities.

One of the most important aspects of the immunization program is the cold chain for the preservation and transportation of vaccines. Most vaccines if not kept at refrigerator or freezing temperatures will quickly lose their potency. Vaccines arrive in Africa from the manufacturers in Europe and North America by air, usually well packed in insulated containers. The first phase of the cold chain involves reception of the vaccine at the airport. Procedures must be developed in each immunization program to meet each vaccine shipment at the airport, quickly clear customs, and unpack and place the vaccines in refrigerated storage facilities. The second phase involves the distribution of the vaccines to the various vaccination clinics throughout the country while maintaining the vaccines at zero or below zero temperatures. Once the vaccines arrive at these centers, they must be stored at these temperatures until used. With the cooperation of the Customs Department a special provision in the customs law was made to exempt vaccines from customs duties. Immunization personnel were assigned to be at the airport when a vaccine shipment was expected. Occasionally vaccines arrived on another flight and program personnel were not there to meet the shipment. In this case, airline freight personnel were instructed to place the vaccines in the airport's cold storage chamber. The Congo, using health development funds from its own budget, invested more than \$60,000 for the construction of a central cold chain unit in Brazzaville that included a cold room, two large refrigerators, two freezers, and an emergency electrical generator. An alarm system that sounded when there were significant temperature changes in the refrigeration and freezers was installed by the World Health

Organization. Two storekeepers were trained to properly arrange the vaccine stocks in the refrigerators, to keep records of the reception and expedition of vaccines, and to check twice daily the temperatures in each unit.

Since the internal air service in the Congo is extensive and reliable, it was decided to ship all vaccines to the interior of the country by air. Special vaccine carriers, capable of keeping vaccines at proper temperatures for at least three days were donated by the United Nations Children's Fund. These carriers were distributed one to each health district and the remaining ten to the central cold chain in Brazzaville, allowing a rotation of cold boxes between the field and the central cold chain. In Brazzaville and Pointe Noire, electricity is normally available twenty four hours per day, however, in some areas there are occasional power outages. Each health center was equipped with a small refrigerator that operated on electricity, but could be operated in an emergency on bottled gas. In the interior of the country, some areas have electricity, but only during evening hours. In these areas, specially designed electric refrigerators capable of storing vaccines at satisfactory temperatures on only six hours a day of electricity were provided. In the rural zones without even an intermittent source of electricity, refrigerators that operate on kerosene or on car batteries were distributed.

The first three vaccination centers were opened in Brazzaville in November, 1981. These centers were located in maternal and infant care (MCH) clinics where mothers usually receive their prenatal consultations and later return with their newborns for postnatal well-baby care. In the Congo, most mothers return to the MCH clinics until their child reaches six months of age. Clinic personnel, who had received the EPI "mini-course", conducted vaccination sessions for the mothers (tetanus vaccine to prevent neonatal tetanus) and the children two days per week. At first the vaccination sessions appeared chaotic. Mothers often had to wait long periods of time for vaccinations. Clinic personnel were exhausted after each session. Records were not well kept. Gradually, the situation improved. Clinic personnel became more efficient. Vaccinations were provided rapidly. Mothers didn't wait as long. Clinics regularly reported their vaccinations. A system had developed and vaccinations had become integrated into the regular well baby health care program that included health education, nutrition counselling, and measuring the growth of each infant. As the vaccination sessions became more organized, an interesting phenomenon developed - more mothers came to the MCH clinic to seek vaccinations and receive well-baby care. The word had spread that something good was being done at the clinics and more mothers wanted their infants to participate in the program. Not only were new children coming to the clinics, but more of those infants who had been vaccinated at one month of age continued to come for their second and third diphtheria, tetanus, whooping cough and polio immunizations given at four to six months of age. Soon the

clinics had to add an additional day or two each week just to provide for the increasing demand for vaccinations. The vaccination program was increasing demand for all child health services!

Each month, personnel in three additional MCH centers were trained in the techniques of vaccination. They were given equipment and vaccines and began to provide vaccinations as part of their well baby care program. Seven months after the national EPI training course, all nineteen MCH clinics in Brazzaville were providing vaccinations on a routine basis! The same strategy was launched in Pointe Noire during the summer of 1982. By September, 1982, all four MCH clinics in Pointe Noire were providing vaccinations.

The program continued to expand. Training programs were planned for the interior of the country. Two rural pilot primary health care zones were equipped and personnel trained to provide vaccination service. A monthly newsletter was published to provide the government and each health center with current information about disease patterns, vaccinations, and program changes. An international evaluation team, supported by the World Health Organization visited the program in November, 1982. Their report was favorable - the EPI had met or exceeded all its program goals set for the first two years - in only 18 months of operation!

In January, 1983, the annual statistical report for the EPI was

prepared. The data showed that the strategy of opening vaccination centers in the MCH clinics was a success. In 1981, in Brazzaville and Pointe Noire 23,459 infants were vaccinated with BCG vaccine. In 1982, 40,241 infants received their BCG. In 1981, in Brazzaville, a total of 20,754 doses of diphtheria, tetanus, whooping cough, and polio (DTC/P) vaccine was given. In 1982, over 57,000 doses of DTC/P were administered. More importantly, 75% of all children receiving their first DTC/P vaccination were returning for the important third dose that increased their protection against these diseases. Measles vaccinations increased by 46% to 13,313 doses in Brazzaville.

To confirm data received in the vaccination reports, a scientific survey of the Brazzaville infant population was conducted to determine the number of children actually vaccinated. Over ninety percent of children had received their BCG vaccination. Eighty percent received their first and second DTC/P vaccinations, and 76% received their third DTC/P. The measles vaccination coverage rate was however not satisfactory. Only 54% of the children surveyed has received their measles vaccination. This was not great enough to prevent outbreaks of measles in the child population. It was only a matter of time before a an epidemic of measles would threaten the lives of young children in the Congo.

The increase in measles cases was first noted in the disease surveillance system in early January, 1983. Measles continued to increase in Brazzaville during January and February, finally

subsiding in late March. It was too late to do anything, except count the cases, and develop a strategy that would increase in the future the numbers of children vaccinated against measles. Program data showed a clear pattern - mothers brought their children to the clinics regularly for their vaccinations up to the age of six months, but they did not return when the child was nine months for the measles vaccination. A survey of these mothers indicated that most mothers forgot about the measles vaccination, or didn't have time to return to the clinic. Interestingly, however, each of the mothers of children not vaccinated against measles indicated they had taken their child for the clinic for consultations for illnesses at least five other times during the past year. The children were being brought to the clinics after six months of age, but not for vaccinations!

A new strategy was developed - health education would be improved. Mothers would learn of the importance of measles vaccinations at the clinics, on the radio, and from older children who would receive educational materials at their schools. In addition, all children coming to the clinics for treatment of illnesses would be required to have their vaccination record with them. Clinic personnel would examine the cards and if the child was not vaccinated against measles, the vaccination would be performed immediately before treatment for the illness would be given. Immediately the numbers of children being vaccinated against measles began to increase.

The real results - reduction of the appalling high infant morbidity and mortality from six childhood diseases - are not yet in. The Congo EPI program is too young to have demonstrated a real impact on these diseases. The new measles strategy has only been in place a few weeks, but more children are being vaccinated. All indications are that the numbers of vaccinations being given will surpass those of 1982, creating even a better vaccination coverage in the urban areas. The EPI is presently reaching about 65% of the infant population. But the future is bright. A well established management system is in place. Vaccines are stocked and ordered on a regular basis. Clinic personnel have been trained to administer vaccinations correctly and to report their activities in a timely manner. There is a sensitive disease surveillance system that can detect disease outbreaks. Most importantly, this expanded immunization program is integrated into the Congolese health system, managed by trained Congolese personnel, and able to insure future program successes after the depart of the American technical officer.

Congo is one country where the "inability to provide each infant with five dollars worth of vaccine" has been overcome not only by the input of money but also by the establishment of a permanent and effective management system.