SPECIAL ARTICLE

REDUCTION OF MORTALITY IN RURAL HAITI THROUGH A PRIMARY-HEALTH-CARE PROGRAM

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Abstract Deaths and their causes in a rural Haitian population of 8820 were studied through hospital records, death registration, a disease survey, and health surveillance. The results were used in selecting eight diseases for the delivery of health services by village-level health workers. The impact of the services was measured by monitoring annual age-specific and disease-specific mortality rates and by comparing them with officially estimated national mortality rates. Mortality rates fell progressively during five years, to levels only one fourth as high as the national estimates. The fall in mortality was associated principally with services that prevented deaths due to tetanus, malnutrition, diarrhea, and tuberculosis. The total program of hospital and village health services saved 495 years of potential life per thousand population per year. Most of the saving was attributable to preventive services. The program eventually served more than 115,000 persons, and it has been replicated by other agencies for an additional 135,000 Haitians. (N Engl J Med. 1981; 304:1324-30.)

PRIMARY-health-care programs for rural populations in less-developed countries are now being implemented and reported by governments, international agencies, and private voluntary organizations.[1-8] These reports show that better methods are needed to assess a population's health needs, to distribute services equitably, and to measure the impacts of programs. Our report describes methods for reaching these goals and measures the impact of a program on the health of a population in rural Haiti. The need for brevity makes it impossible to describe the background and methods in as much detail as can be provided in reports dealing with a single disease such as tuberculosis, tetanus, or malnutrition. However, we have tried to mention the characteristics that are essential to an understanding of the results that we obtained.

BACKGROUND

According to several criteria, the Republic of Haiti, occupying the western end of the island of Hispaniola, is the Western Hemisphere's poorest nation. Haiti's 5 million citizens had a mean annual gross national product of only $280 per capita in 1978[9]; they have a high prevalence of chronic malnutrition,[10,11] an infant mortality rate of 150 per thousand live births, a life expectancy of 47.5 years at birth, and a birth rate of 37 per thousand population.[12,13] Approximately 80 per cent of Haitians live in rural areas and derive their living directly from agriculture. Agricultural production appears to be constantly threatened by erosion and periodic droughts and hampered by primitive farming methods.

The Albert Schweitzer Hospital, a 140-bed general hospital funded by private donations and the Grant Foundation of Pittsburgh, Pennsylvania, and operated by permission of the government of Haiti, opened in 1956 in Deschapelles, Haiti. It presently serves a population of more than 115,000 rural Haitians living in a district of 380 km². The hospital annually provides approximately 70,000 outpatient consultations, 3000 hospital admissions, and 60,000 patient-days of hospital care. Although outpatient consultations are primarily for curative care of patients with disease, the hospital provides such preventive services as health education, screening for tuberculosis and malnutrition, and immunization against tetanus, diphtheria, pertussis, and tuberculosis during the consultations. All curative and preventive services are provided for a token fee, and the receipts from these fees supply 3 per cent of the hospital's annual budget. In 1968, the hospital instituted a Department of Community Health to provide preventive services free of charge in the villages to all inhabitants of the hospital district.[14]

The purpose of the Department of Community Health was to improve the health of the people inhabiting the hospital district. To accomplish this end, the Department set out to deliver appropriate health and nutrition services at the village level. Achievement of this goal required identification of the health problems, identification of the persons at risk for each problem, and planning and provision of appropriate services for the persons at risk.

The Department's plan of action entailed performing all three functions simultaneously and gathering data to evaluate the impact of the services. Through this plan, all members of a defined population are identified and counted, the members needing certain health or nutrition services are identified and served, all deaths are identified, and the cause is certified. From these data the rates of births, deaths, and certain diseases can be calculated. The rates and annual changes in the rates are analyzed to plan services and

to evaluate the impact of the program on the population's health.

Such systematic and iterative gathering and interpretation of health information from a defined population is called health surveillance; this process and the provision of health services are mutually supporting aspects of the Albert Schweitzer Community Health Program and are performed concurrently by the same personnel. This report will show how health surveillance and health services, in concert with the services offered by the hospital, saved lives and increased the population's life expectancy. The results reported are from a population, measured by census, that grew from 8820 residents in 1968 to 9612 in 1972. After 1969, the services that produced the results were extended progressively to neighboring populations; by 1979, all 115,000 people inhabiting the hospital district were served. Data collection and analysis were restricted to the original census-tract population as an economy measure.

METHODS

Description of the Population and Vital-Registry System

The first persons to benefit from the health surveillance–health services program were the 8820 residents of 23 villages in a 28-km² area surrounding the hospital. Residents of this census tract were persons who lived within its boundaries for at least six months of the year and infants who were born of resident mothers.

Births, deaths, and migrations of residents were reported by community collaborators selected from among volunteers in each village. Each collaborator was responsible for a neighborhood of 100 families. Reports from collaborators were verified through home visits conducted by members of the professional staff. Causes of reported deaths were certified by a physician who based his diagnoses on information gathered from the family of the deceased, from hospital records, and in 18 per cent of the cases, from autopsy results. Deaths were registered by underlying cause, with the *International Classification of Diseases* List A, 1965 revision,[15] used for tabulation purposes.

Assessment of Service Needs from Mortality and Morbidity Information

In order to assess needs for service as revealed by available morbidity information, hospital records on work performed before 1968 were studied. This study indicated that tetanus was the most common cause of admission, accounting for 13 per cent of all admissions; that cases of malnutrition were the greatest consumers of days of hospital care, accounting for 23 per cent of the total annual number of hospital days; and that tuberculosis and diarrhea were the greatest consumers of ambulatory-clinic services, accounting for 25 per cent and 18 per cent of outpatient consultations, respectively. Since the precise size of the denominator population from which patients with these diseases were admitted was not known, no inferences about the incidence of specific diseases in the hospital district were drawn.

The prevalence of tuberculosis was studied by examination of the entire census-tract population. A survey in 1969 tested the skin reactivity of residents to intermediate-strength purified protein derivative of tuberculin (PPD), which was administered intradermally by jet injector. Persons with at least 10 mm of induration at the injection site after 48 hours were examined clinically and with chest x-ray films. Eighty-two per cent of the residents had all the relevant tests. Persons with lymphadenopathy or x-ray shadows that were characteristic of tuberculosis were presumed to have tuberculosis; they were treated on an ambulatory basis with antituberculosis drugs and were followed with repeated x-ray films and spu-

tum examinations for at least 18 months. A patient's treatment was stopped when follow-up examinations were negative for six months. The presumed cases were treated with self-administered isoniazid, 300 mg per day, and aminosalicylic acid, 12 g per day, for 18 to 24 months. Children were given appropriately smaller doses.

For further assessment of the population's needs for service, deaths of census-tract residents during the first year of surveillance were analyzed according to category of underlying cause. In addition, recent mortality rates among infants and children were measured from retrospective interviews of all mothers in the census tract. The 2570 mothers reported 2144 deaths among their 7743 live-born children, and cross-tabulation of these data provided estimates of annual mortality rates (Berggren W, et al. Unpublished data).

Mortality and morbidity information from health surveillance, surveys, hospital records, and maternity histories indicated that malnutrition, diarrhea, tuberculosis, and tetanus should be target disease categories for preventive services. Prevention of tetanus required immunization of the population — a service that was easily expanded to include prevention of measles, pertussis, diphtheria, and poliomyelitis with little increase in cost. Although these four diseases caused no mortality among the study population during 1968, they are known to occur in epidemics that may cause considerable morbidity and mortality (Berggren W, et al. Unpublished data). The health services were therefore designed to prevent deaths due to eight categories of target disease: malnutrition, diarrhea, tuberculosis, tetanus, pertussis, diphtheria, measles, and poliomyelitis.

Malaria was not among the target diseases because it was well controlled by the National Malaria Eradication Service[16] through house spraying and chloroquine distribution. No cases of malaria were diagnosed among the census-tract populations in 1968.

Description of Services

Eight categories of preventive services were offered to the population and were delivered at quarterly neighborhood gatherings or "health rallies" held at strategically located "rally posts." A rally post was easily accessible to 1000 to 1500 inhabitants. A community collaborator personally invited each inhabitant to attend the rally post closest to home. On rally days, the collaborators were assisted by a physician or nurse and by five to 10 auxiliaries in delivering the eight categories of services described below. The few persons requiring medical attention were treated by the physician at the rally or were referred to the hospital.

Lessons in Health and Nutrition

Residents arriving at a health rally were seated in groups of 20 to 30 persons and were given 15-minute illustrated talks on nutrition, sanitation, or other health-related topics. The lessons were taught in the vernacular by nurses, physicians, or auxiliary health workers, and they covered such topics as disposal of excreta, breast feeding, the frequency and content of child feeding, the availability of family planning, or the method of oral rehydration for treatment of diarrhea. Parents were given a "Road-to-Health" card for each child in order to teach them that the child must gain weight.

Targeted Supplemental Feeding

Supplemental feeding was used as emergency home treatment of severely malnourished children who were discovered through weight monitoring. In order to identify those in need of supplemental feeding, all children six years old or younger were weighed, measured, and examined for pretibial edema at the time of each rally; weights were recorded graphically on Road-to-Health cards, which were kept by the child's parents.[17] Fourteen per cent of the rally appointments were missed, and home visits were performed in such cases to record the child's weight.

Children were categorized according to the Gomez classification with the Harvard standard of weight for age.[18,19] Children with third-degree malnutrition or negative weight increments either received supplementary food or were referred to a "mothercraft center" for rehabilitation. According to these criteria, about 5 per

cent of the children up to six years old were eligible for supplementation.

The supplementary food package consisted of 1.2 kg of powdered skimmed milk fortified with oil and sugar in proportions (by weight) of 4:1:1.[20] The daily ration contained approximately 350 kcal and 20 g of protein. The children were followed at a fortnightly clinic held on the hospital grounds and were resupplied until they gained weight at a rate equal to that of Boston children of the same age or were no longer classified as having Grade III malnutrition.

Demonstration Education

Since management of malnutrition over the long term requires the efforts of educated and motivated parents, a program of demonstration and education was instituted to expand and reinforce the lessons on nutrition that were taught at the health rallies. This method, developed by the Haitian Bureau of Nutrition, involved parents in the rehabilitation of their malnourished children.[21,22] Mothers of children who were underweight for their ages were given supervised practice in appropriate child feeding, and they witnessed the therapeutic effectiveness of such feeding in community nutritional education and rehabilitation centers, which were sometimes called mothercraft centers.[21-23] Centers were established in local homes and employed foods, utensils, and methods of preparation that were familiar to the mothers. Underweight children attended a center six days per week for 13 weeks, receiving a balanced and calorically adequate diet. Mothers or guardians of the enrolled children attended for one day per week in rotation. By participating in the work of the center, they learned that the usual adult one-meal-per-day regimen had to be supplemented with frequent feedings in young children, and they practiced preparing adequate meals from indigenous, inexpensive foods.

Each center served a neighborhood of 400 to 600 families. New groups of 24 to 30 mothers and their underweight children were recruited every three months until all mothers of children weighing less than 80 per cent of the expected weight for their ages had attended one three-month session. The nutrition teacher and the center's utensils were then moved to another area.

Oral Rehydration

Oral rehydration of children with diarrhea was taught at health rallies, in nutrition centers, and in the ambulatory clinics of the hospital. Parents were shown how to prepare a rehydration solution[24] from locally available sea salt, sucrose, and potable water, using the large spoon, empty rum bottle, and bottle cap that are present in every rural home as measuring utensils. Lime juice, which is traditionally esteemed for its flavor and supposed medicinal value, was also added to the rehydration fluid. Parents were instructed to administer the solution by cup or spoon, to continue breast feeding, to recognize signs of dehydration, and to bring dehydrated or vomiting children to the hospital.

Screening and Treatment for Tuberculosis

In addition to the survey for tuberculosis described above, routine chest x-ray films were taken of malnourished children who did not gain weight after adequate feeding in a nutrition center. Patients with presumably active tuberculosis thus diagnosed were treated with isoniazid and paraaminosalicylic acid, and were followed up with clinic and home visits. During the visits, urine was tested for evidence of paraaminosalicylic acid excretion, attention was paid to patients who were not taking their medication or were not attending the monthly clinic, and patients and their families were counseled as necessary.

Deworming

Piperazine citrate syrup, 100 mg per milliliter, was administered at health rallies. Children six months to three years old were given 15 ml of the syrup in a single dose; older children received 20 ml. This treatment had a twofold purpose. Heavy burdens of ascaris worms were reduced, and the observation of passage of large numbers of worms was of benefit in maintaining parental interest and attendance.

Immunization

Children three months to four years old were inoculated with diphtheria-pertussis-tetanus toxoid (DPT) and were given trivalent poliomyelitis vaccine. Three doses of DPT were given at one-month intervals, and a fourth dose was given one year after the third. Two doses of oral trivalent poliomyelitis vaccine were given with an interval of two months. Children one year old or older were given measles vaccine unless they had been born before January 1967, which was the end of the last measles epidemic. Persons older than six years were inoculated with three doses of tetanus toxoid at intervals of one to three months.

All inhabitants of the hospital district were vaccinated with bacillus Calmette–Guérin (BCG) if the PPD test resulted in less than 5 mm of induration after 48 hours.

Skin testing, vaccination, and recording were all done by auxiliaries, who were supervised by a nurse or physician. New residents (immigrants and neonates) were identified by the village volunteers, given immunization cards, and immunized at the health rallies.

Support of the Traditional Birth Attendants

Eighty-five per cent of mothers delivered their babies in their homes, usually with the assistance of a traditional birth attendant (TBA). The hospital supplied 175 TBAs with sterile razor blades, cord ties, and umbilical dressings. Theses items were packaged, sterilized, and distributed monthly at meetings of TBAs. To receive supplies, a TBA had to attend five training sessions given by the hospital's professional staff and to demonstrate an ability to use the materials correctly.[25]

TBAs instructed parents to take the baby and the immunization card of the mother to the hospital soon after birth so that BCG vaccine could be administered. Neonates whose mothers were incompletely vaccinated against tetanus were given prophylactic tetanus antitoxin in addition to routine BCG vaccination.

Personnel

The clinical services of the 140-bed hospital were staffed by a radiologist, three pediatricians, three internists, three surgeons, 30 nurses, 60 auxiliary nurses, and several technologists and many auxiliary personnel who worked in the laboratory, x-ray facility, pharmacy, record room, business office, housekeeping department, and other areas. The Community Health Program was eventually provided to the entire hospital district of 115,000 people by a rural sanitary officer, two nurses, three physicians, 30 full-time auxiliaries, and 60 community collaborators.

The health auxiliaries were recruited from among local farmers with sufficient skill in reading and writing to execute the routine reports. Many of them began working as collaborators. The training was progressive in that new recruits first worked for two to three months on a daily-hire basis and received on-the-job training in specific tasks such as census taking, weighing, measuring, recording, and injecting vaccines. On-the-job training involved one task at a time, performed under the supervision of the professional staff. The recruit was given maximum experience in performing one task before a different duty was taught. By the time a recruit acquired sufficient training to be considered for employment on a full-time basis, her or his personal commitment to community-health work had been adequately demonstrated. As auxiliaries became expert in their tasks, some of them were given responsibilities that included training and supervision of their juniors.[26]

In general, the community collaborators volunteered their time. However, they were paid for two days for each rally (one day for preparation) and for days spent working on the annual census.

RESULTS

Combined Impact of Hospital Services and of Health Surveillance and Health Services

The health and lives of census-tract residents were protected by easy access to the hospital and free pre-

ventive care through the health services. One can measure the effect of this protection by comparing the census tract with the rest of Haiti. We made this comparison on the basis of mortality rates, deaths averted, and years of life saved.

Age-Specific Mortality Rates

Annual age-specific mortality rates in the census-tract population were far below the mortality rates estimated for the total population of Haiti. In 1972, for example, the one-to-four year mortality rate in the census tract was less than one third of the national estimate, and the infant mortality rate was only one fifth of the national estimate (Table 1). Mortality rates at the ages of five to 39 years were only one sixth as high as the national estimates.[12,13]

Deaths Averted by the Program

If the national age-specific mortality rates are applied to the age distribution in the population of the census tract, the resulting expected number of deaths for 1972 would be 171.1. Only 72 deaths were observed in 1972 — 99 fewer than expected. It is assumed that this difference is caused by the health services offered in the census tract, and that the services therefore averted the deaths.

Years of Expected Life Saved

In order to calculate the number of years of expected life that were saved by the health services, we make certain assumptions. The 99 residents whose deaths were averted in 1972 can be expected to die at a rate determined by their age and by their health care. We can assume that if the health-care services provided by

the hospital and its Department of Community Medicine had ceased at the end of 1972, residents of the census tract would have continued to die at the same annual rate found in their birth cohorts in the rest of Haiti. Therefore, the number of years of expected life saved in each age group by 1972 is equal to the number of deaths averted in each age group multiplied by the national life expectancy of that age group.[28] Summation of these products reveals that a total of 4758 years of expected life were saved during 1972. Division of this sum by the midyear population shows that 495 years of expected life were saved per thousand population.

Impact of Health Surveillance and Health Services

By 1972, life expectancy at birth in the census-tract population had increased to 66.4 years — 18.9 years above the national level (Table 1). This difference resulted from the combined impact of the hospital services and the health surveillance and health services. The hospital services probably achieved their maximum impact during the 12 years before the health surveillance and health services began. The impact of health surveillance and health services is therefore reflected in the changes in mortality rates after 1968. The earliest data for comparison are for 1968, when registration of births and deaths was instituted. Comparing 1968 with 1972 underestimates the impact of health surveillance and health services, since the mortality rates during 1968 were almost certainly lowered by the program of surveillance and services. However, even this underestimate indicates a considerable impact.

The effect of health surveillance and health services

Table 1. Measures of Mortality Trends during 14 Years in the Albert Schweitzer Hospital Census Tract in Comparison to Haitian National Estimates for 1972.*

AGE GROUP	CENSUS TRACT							NATIONAL ESTIMATE
	RETROSPECTIVE		PROSPECTIVE					
YR	1958–1962	1963–1967	1968	1969	1970	1971	1972	1972
Infants †	174	110	55	68	47	37	34	150
1–4	24	14	11	7	9	5	6	23
5–9	8	3	3	2	1	4	1	6
10–14	NA	NA	2	<1	1	1	<1	4
15–39	NA	NA	3	4	2	2	2	11
40–64	NA	NA	19	9	9	13	9	20
≥65	NA	NA	90	73	67	65	69	110
All	NA	NA	13	9	8	9	8	18 ‡
Life expectancy (S.E.) §	NA	NA	57.1 (1.1)	61.9 (1.3)	64.7 (1.1)	63.8 (1.1)	66.4 (1.1)	47.5

*All rates are expressed as the number of deaths per thousand population per year. Five-year mean annual mortality rates for 1958-1962 and 1963-1967 were calculated from retrospective maternity histories. Prospective rates for single years were calculated from tabulated births and deaths registered during health surveillance. The national estimate was obtained from a multi-round demographic survey conducted from 1971-1973.[13] NA denotes not available.

†Infant mortality is expressed as the number of deaths of children 11.9 months old or younger per thousand live births.

‡Standardized to 1972 census-tract populations.

§These figures are the actual life expectancies observed in the population during these years. The standard errors should be used to test whether the underlying risks of dying changed significantly between years. These standard errors were calculated with the formula given by Keyfitz,[27] with the variance of the death rate in each age group based on the Poisson distribution because of the small number of deaths.[29] With these values for the standard errors, the life expectancies in each of the four years from 1969 to 1972 are significantly greater than the corresponding value in 1968 (P<0.01).

Table 2. Disease-Specific Mortality Rates by Year in the Albert Schweitzer Hospital Census Tract from 1968 to 1972.

DISEASE CATEGORY	ICDA No.*	DEATHS		MORTALITY RATES †					REDUCTION OF MORTALITY RATE
		1968	1972	1968	1969	1970	1971	1972	1968–1972
									%
Malnutrition	267.0–268.0	19	9	2.2	1.5	0.5	1.0	0.9	59
Diarrhea	9.1–9.2	11	6	1.2	0.7	0.9	0.6	0.6	50
Tuberculosis	11.0–17.9	7	4	0.8	0.4	0.1	0.5	0.4	50
Tetanus	37.0	2	0	0.2	0.0	0.0	0.0	0.0	100
Subtotal, all target diseases ‡	—	39	19	4.4	2.6	1.5	2.1	2.0	55
Subtotal, all other diseases	—	73	53	8.4	6.7	6.6	6.3	5.5	35
Total, all diseases	—	112	72	12.8	9.3	8.1	8.5	7.5	41

*International Classification of Diseases, List A number, 1965 revision.

†Expressed as the number of deaths per thousand persons per year.

‡Target diseases included malnutrition, diarrhea, tuberculosis, tetanus, pertussis, diphtheria, measles, and poliomyelitis.

may be estimated by a calculation of the change in target-disease-specific death rates between 1972 and 1968 (Table 2). From 1968 to 1972, deaths due to malnutrition, diarrhea, and tuberculosis declined by 50 per cent or more, and the five other target diseases caused no mortality at all (Table 2). Mortality rates for the target diseases taken as a group declined by 55 per cent from 1968 to 1972; meanwhile, mortality rates for all other (nontarget) diseases declined by only 35 per cent.

With the target-disease-specific mortality rates of 1968 and the 1972 population size, the expected number of deaths due to target diseases in 1972 is 41, whereas the observed number was 19. Thus, assuming that the services caused the differences between the 1968 and 1972 rates, the lives of 22 persons, who are expected to live an additional 1064 years, were saved (Table 3). This benefit amounts to an annual saving of 111 years of expected life per thousand population.

The full impact of health surveillance and health services is underestimated not only by the use of 1968 as a base line but also by the use of the census tract to calculate mortality rates in rural Haiti in 1968. Since 1956, the hospital clinics had provided many of the same services[29] that the health surveillance and health services began to deliver at the village level in 1968. The hospital services naturally had the greatest impact on persons who lived close enough to the hospital to make use of them. Therefore, some of the effect accomplished by the hospital in the census tract would be produced by health surveillance and health services in areas that were more distant from the hospital. The hospital's program of routine tetanus vaccination is a clear example of this problem. Before 1968, tetanus immunization was available only to schoolchildren and persons who came to the hospital clinics and was therefore effective only for the schoolchildren and for that proportion of the clinic's patients who returned after intervals of a month or more

to complete the series of injections. Thus, the program's impact on mortality rates was concentrated in the population living in closest proximity to the hospital — i.e., the inhabitants of the census tract.

In order to estimate the impact of the extension of the tetanus-vaccination program beyond the census-tract population, it is necessary to estimate the death rate from tetanus before immunization began. Two such estimates of the tetanus mortality rate are available for neonates, who constitute the group with the highest risk. The rate of hospitalization for tetanus among neonates in the hospital district in 1967 was 64 per thousand live births.[14] This figure is certainly an underestimate of tetanus-specific mortality, since the case-fatality rate in the absence of treatment is almost 100 per cent, and since many affected persons from the hospital district never reached the hospital. The hospital's antenatal-vaccination program was initiated at the end of 1961, and it is estimated from maternity histories collected in the census tract that the tetanus-specific mortality rate for that year was 145 per

Table 3. Deaths Due to Malnutrition, Diarrhea, Tuberculosis, or Tetanus and Years of Life Saved by Health Surveillance and Health Services in the Albert Schweitzer Hospital Census Tract, 1972.

AGE GROUP	NO. OF EXPECTED DEATHS	NO. OF OBSERVED DEATHS	NO. OF AVERTED DEATHS	PERCENTAGE OF EXPECTED DEATHS AVERTED	LIFE EXPECTANCY AT MEAN AGE OF GROUP	YEARS OF LIFE SAVED
YR					YR	
0–1	11	3	8	73	51.0	408
1–4	11	5	6	55	55.0	330
5–9	4	2	2	50	53.8	108
10–14	1	0	1	100	50.2	50
15–39	5	1	4	80	39.5	158
40–64	3	3	0	0	21.4	0
≥65	6	5	1	17	9.8	10
Total	41	19	22	54	—	1064 *

*111 years of life per one thousand person-years.

thousand live births. This figure is therefore a reasonable estimate of the tetanus-specific infant-mortality rate among a nonvaccinated rural Haitian population.

Using each of the above estimates of tetanus-specific infant mortality in turn, and assuming a constant birth rate of 37 per thousand population (approximately that of the census tract), we can estimate that the tetanus-vaccination program prevented between 2.4 and 5.4 neonatal deaths per thousand population per year. Based on the national life expectancy of 51 years, our estimates show that the savings are between 122.4 and 275.4 person-years of expected life per thousand population. With these savings added to those attributed to health surveillance and health services in the census tract, the estimated total savings attributable to the new programs are between 233 and 386 years of life per thousand population, or between 47 and 78 per cent of the total savings. Of the two, 78 per cent is the more likely estimate of the proportion of lives saved by the health surveillance and health services outside the census tract.

DISCUSSION

Health impact is defined in this report as changes in mortality rate that are associated with the provision of health services. The study shows associations in time, age group, place (Table 1), and specific disease category (Tables 2 and 3) between the provision of services and the decline of mortality rates. A demonstration of these associations does not prove that the health services caused lower mortality rates, but since all four types of association are in agreement, they strongly support the hypothesis of causality.

Socioeconomic factors were not monitored during the study period, but there is no reason to believe that they changed substantially or that this population is unrepresentative of the total population of Haiti. For example, the prevalence of malnutrition of Grades II and III among census-tract children in 1968 was similar to that found in studies of the national population.[10,11] Housing appeared to be just as poor and crowded in the census tract as it was in other rural areas of Haiti. Food preparation in the family was carried out in the manner that is customary in all areas of Haiti: on the ground in unsanitary shelters that were poorly supplied with water for washing hands or utensils. Latrines were few, infrequently used, and poorly maintained. Less than half the population had easy access to a protected water supply. Therefore, if there were notable differences in socioeconomic levels between the census tract and the rest of the country, these differences were not reflected in practices affecting health.

We measured the program's impact on mortality by converting the changes in mortality rates to the number of lives (or years of expected life) that were saved per thousand population. These measures can be conveniently used to compare the effectiveness of alternative health programs.[28] The use of years of expected life saved per thousand population emphasizes the importance of protecting younger members of the population, who can be expected to live longer than older persons.

The hospital services and the health surveillance-health services program together lowered age-specific mortality rates, saved 10.4 lives per thousand population, lengthened life expectancy, and annually saved 495 years of life per thousand population. About 50 to 80 per cent of the probable total impact of the program outside the census tract can be attributed to health surveillance and health services.

Health planners in low-income countries must seek ways to deliver more effective health services to the largest number of people within the constraints of limited budgets. For example, the Haitian Ministry of Health has a current annual operating budget of only about $2.75 per capita. In addition, they have about $2.90 per capita to be used for the capital expenditures, training, and other costs associated with extension of the health system. International aid provides a great deal of the development funds.

This paper demonstrates that health surveillance and health services reduced mortality effectively even in a population that already had access to an established hospital. The average annual cost of adding health surveillance and health services to the hospital services for the five-year period studied here was only $1.60 per inhabitant per year. This amount includes some program-development costs and the initial training costs. Inflation and extension of the program to more distant populations have increased the cost of this program, just as they have increased the cost of alternative approaches. However, a relatively low cost is ensured by the program's dependence on locally recruited village-level health workers.

Since 1972, when the expatriate director of the program was succeeded by a Haitian physician, the population covered by the health surveillance-health services program of the Albert Schweitzer Hospital has reached 115,000. Similar programs have been initiated by private organizations to serve 20,000 persons in another rural area and 80,000 in an urban slum. This latter program is now receiving additional funds from the United States Agency for International Development. A pilot project in a rural area with a population of 33,000 was initiated by the Haitian Department of Public Health, Division of Family Hygiene. This project studied the impact of health surveillance and health services combined with different levels of expenditure for clinical services. It demonstrated that the presence of clinical services did not add to the impact of health surveillance and health services.[8] The cost figures for the government program are comparable to those for the program reported here.

Health surveillance and health services are designed to ensure that scarce resources are used efficiently to attack the most frequent and serious preventable diseases in the population. They accomplish

this goal in two ways. In the first place, the use of village-level health workers makes it possible to ensure complete coverage of the population without incurring large expenses. Secondly, the data from the surveillance system make it possible to keep the program focused on the high-priority needs of the population. For example, the data from the census tract indicate that after 1972 the nutrition centers had reached all the mothers of malnourished children, that the prevalence of the original target diseases had decreased, and that there was a resurgence of malaria. This kind of information can guide changes in the program so that the services provided reflect the needs of the population rather than the habits or preferences of the providers. In these ways, health surveillance and health services provide the key to cost-effective use of the more expensive and scarce resources of health professionals and the supplies and equipment that they require.

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