Epidemiologic perspective of diarrheal disease in Costa Rica and current efforts in control, prevention, and research

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ABSTRACT: This paper shows that mortality due to diarrheal diseases in Costa Rica began to decline in the 1940's. After a period of arrest during 1948-1964, the decline reached a low of 12 deaths per 100,000 population in 1977. The first decrease in diarrhea mortality coincided with concurrent social reforms and an increase in income in the country. Stagnation correlated with social unrest, civil war and substantial population growth. The recent rapid decline was coincidential with an overall improvement of health services, income and the quality of life.

The paper also deals with research on the etiology and treatment of diarrhea in Costa Rica, and with advances on oral rehydration as a life-saving measure. This research established that rotavirus, and to a lesser extent, bacteria, are the main agents of diarrhea among children attending the hospital. Oral rehydration was shown to be a safe and effective way to treat the moderate and severe dehydration of viral an bacterial diarrheas. Other findings showed the need to increase the potassium concentration in oral solutions; that sucrose and glucose were equally effective; and that neonates could be treated with schemes and solutions recommended for older children.

Finally, current efforts to further prevent diarrhea and death at the national level, especially in rural areas, were described. A program is under way for distribution of packs throughout the nation. with efforts to transfer oral rehidration technology to mothers and other persons, in order to permit rehidration in the home.

Through a long-term prospective field study conducted by INISA in Puriscal, a drastic change in the pattern of breast-feeding was demonstrated. More than 80 percent of mothers continued breast-feeding their children after the fifth month, a level contrasting with the 40 percent figure recorded in similar areas, in surveys by the Ministry of Health in 1975 and 1978. The increase in breast-feeding in the study population appears related to the romming-in and the promotion of breast-feeding in the hospital. Survival and physical growth of the cohort children are better than expected for rural areas of Costa Rica.

Research in Costa Rica is currently conducted at the National Chilren's Hospital and at the Instituto de Investigaciones en Salud (INISA) with emphasis on oral rehydration, transfer of oral rehydration technology to the home, technique on promotion of breast-feeding, and the epidemiology of diarrheal disease in rural areas.

INTRODUCTION

Like most developing nations, Costa Rica. also had a very high mortality attributable to diarrheal disease at the beginning of the Century. The Capital City, San José, had an estimated 25,000 population at the turn of the Century, and the mortaiity for all causes, according to one of the oldest census, was 41 per 1000 population, only surpassed by that of Alexandria.[9] The estimated diarrheal disease death rate for 1900 was 239 per 100,000 (codes 091 and 092).[20] Clinical descriptions in hospital records of those days suggest that most fatal cases were due to dysentery-like and cholera-like syndromes.

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Mortality due to diarrhea: 1928-1977.

Relatively good data on total population, mortality, and causes of death became available around 1925. The diarrheal disease death rate for the country at that time was extremely high, of the order of 400 per 100,000, but thereafter it started to decline slowly, and more pronouncedly after 1940, Table 1. The high rates recorded in the quinquenium 1928-1932 are comparable to those observed in modern times in several Asian and African nations which are seriously affected by malnutrition and poverty.

Figure 1 depicting the decline in diarrheal disease death rate just mentioned, clearly shows the profound change that the country experimented over a short span. The first marked reduction coincided with the period 1942-1948, characterized by the beginning of social and economic reforms. After stagnation during the following 15 years (a period that began with a

TABLE 1

MORTALITY DUE TO DIARRHEA IN COSTA RICA. 1928-1977

Codes 008, 009 and 561. Code 561 was excluded after 1967

Period	Mean yearly deaths in period	Range of yearly death rates per 100,000	Range of yearly % proportionate mortality
1928-32	1850	320-431	13.8-18.1
1933-37	2082	321-417	16.6-19.1
1938-42	2077	282-398	15.3-20.3
1943-47	1596	157-257	12.1-16.5
1948-52	1179	112-187	9.3-16.1
1953-57	1420	125-158	11.6-15.9
1958-62	1512	120-140	14.2-15.9
1963-67	1703	86-143	12.4-16.6
1968-72	1207	55-84	9.4-15.8
1973-77	516	12-45	2.8- 8.9

After Mata *et al.*, 1980a.

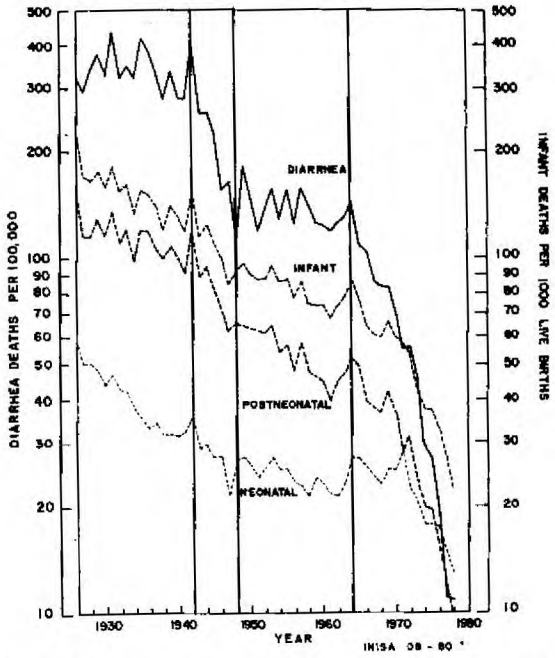

Fig. 1. Infant mortality (neonatal, postneonatal and total, per 1,000 live births, and death rates due to diarrheal disease per 100,000, Costa Rica, 1926-1978. The first decline in mortality due to diarrhea was coincidental with significant social and economic reforms (1942-1948). A revolution, social disruption, migration and demographic explotion marked a span of stagnation (1948-1964) of the previously observed trend. Stability, and social and economic development coincided with the last decline (1965 to now).[3] Note the concordance of peaks of increased diarrhea deaths and infant mortality.

civil war, followed by migration and high population growth) diarrhea deaths again declined steadily from 1964 up to the present.[18,21]

As showed in Table 1, diarrhea deaths accounted for as much as 18% of all deaths in the country from the 1920's throughout the 30's. In the following three decades, diarrhea accounted for 10 to 16% of all deaths, while in the last decade the figure decreased to 2 to 3% The change has been striking for all age groups (excepting persons 15 to 44 years) but even more so for children under 5 years, and for older children, Figure 2.

It is difficult to assess the individual contri-

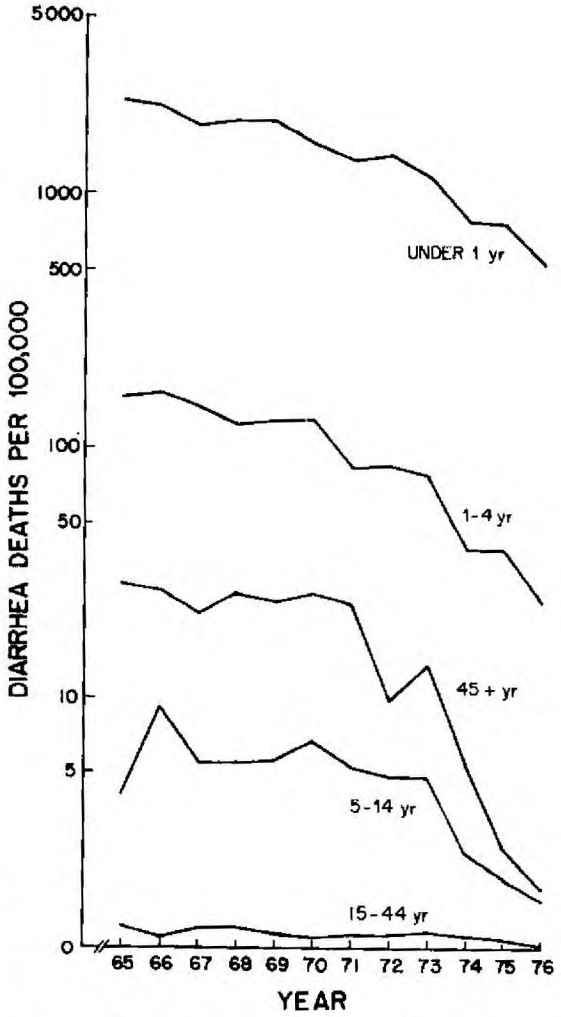

Fig. 2. Age-specific diarrheal disease death rates per 100,000 population in Costa Rica, 1965-1976. The most distinct absolute change occurred among infants and children 1 to 4 years old. A significant decline was observed for older adults.

bution of several factors in the phenomenon described. Probably the main determinant was the rapid change in living conditions in Costa Rica resulting from an emphasis of most governments on social development. Over the last 20 years, there has been a significance increase in *per capita* income ($1,690 in 1979), and personal hygiene has markedly improved as evidenced by sales of clothing, soap, and toothpaste. Water supply, a political weapon in Costa Rica, has been used by candidates and presidents alike, resulting in sustained programs of aqueducts. At present, 98% of the urban population has piped water in the home, and 70% of the rural population enjoys a similar service. Striking improvements in the availability of latrines and toilets have been recorded.

Concomitantly, education has improved steadily and the present rate of illiteracy is about 12%. Teaching emphasizes the concept of disease transmission and the role of hygiene in preventing disease, including diarrhea and intestinal parasitism. Collateral with this, hospital and health services coverage is, at present, virtually universal. Furthermore, greater availability of roads and transport, coupled with more aggressiveness and collaboration by physicians and the public, and the adoption of good methods for rehydration, has resulted in a drastic decrease of diarrhea deaths in the last few years.

Diarrhea, malnutrition and infant death

There is a strong correlation between diarrheal disease and malnutrition and between diarrheal disease and infant mortality.[18] The association of diarrhea with anorexia, nutrient loss, wastage and retarded growth, were all demonstrated in the field.[12,15] The correlation of diarrheal disease deaths with infant mortality [30] was shown for Costa Rica, Figure 3.[18] No important correlation was noted in the period 1926-1942. However, from 1943 to 1978 both indicators were highly correlated. The influence of diarrheal disease on infant deaths was very notorious from 1943 through 1948, but the correlation was very strong in the periods 1949--1964 ($r = 0.69$) and in 1965-1978 ($r = 0.96$).

Even in recent years, more than 95% of all diarrhea deaths in the country occured in infants. Thus, the decline in diarrheal disease mortality appears reflected in the marked decrease in infant mortality, Table 2. As illustrated in Figure 1, the neonatal and postneonatal mortalities were equal or almost equal in 1971, while in 1976 and thereafter, the postneonatal infant

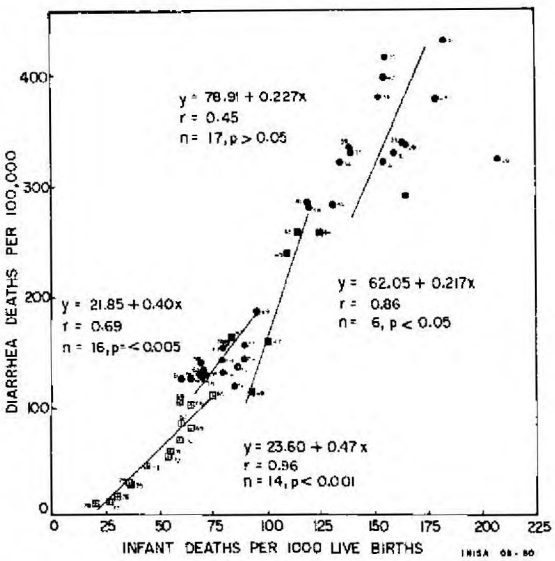

Fig. 3. Correlation between infant mortality and diarrheal disease death rates in Costa Rica, 1926-1978. Numbers next to data points indicate the year of the correlated indexes. Correlations were significant for all periods depicted in Figure 1, except for 1926-1942. Undereporting in 1926 and 1927 probably accounted for lower death rates and this influenced the correlation.

mortality became smaller than the neonatal one. Futhermore, mortality due to severe malnutrition decreased by 65% from 1970 to 1976.[40] It is not surprising that the hospital ward for malnourished children had to be closed in 1978

TABLE 2

EVOLUTION OF INFANT MORTALITY AND DIARRHEAL DISEASE DEATH RATES, COSTA RICA, 1965-1978

Year	*Infant mortality per 1 000 l.b.* Neonatal	Post-neonatal	Total	Diarrheal disease deaths per 100,000 (008, 009, 561)
1965	27.2	48.9	76.1	109.3
1966	25.6	39.5	65.1	104.4
1967	24.3	38.0	62.3	86.1
1968	23.1	36.6	59.7	84.3
1969	25.4	41.7	67.1	82.8
1970	25.2	36.3	56.5	69.6
1971	28.7	27.8	56.5	55.4
1972	22.8	31.7	54.5	55.9
1973	20.8	24.0	44.8	43.9
1974	17.7	19.8	37.5	29.4
1975	17.7	19.3	37.0	27.2
1976	17.5	15.8	33.3	18.2
1977	14.7	12.8	27.5	12.3
1978	13.1	9.2	22.3	11.8

due in part to the virtual disappearance of kwashiorkor and the sharp reduction in the number of cases of marasmus.[11]

One may conclude that further gains in infant survival are expected from a sustained emphasis in control and prevention. Attack should be at the national level, targetting on marginal populations and on those living in remote rural areas, as emphasized by the government in the last three administrations.

Diarrhea morbidity

Only limited data on diarrehal disease morbidity is available for Costa Rica. Studies conducted in 1959-1960 in Barva, a rural population, showed a relatively high incidence of diarrhea among preschool children.[26] At that time, the diarrheal disease death rate was about 120 per 100,000 population, and those deaths accounted for 15% of all deaths in the country. More recent studies carried out in 1966-1967 in rural and urban communities of the Highland Central Plateau, again showed a relatively high diarrhea morbidity.[8] While the methods used in both investigations differed, the results were similar, although in no case the incidence was as high as that shown in other parts of the world, for instance, in Guatemala.[12]

Nevertheless, diarrhea sitll is one of the main illnessess diagnosed in clinics throughout the country. Thus, many cases are still treated every day at the National Children's Hospital, in San José. The profile over the last few years, Figure 4, reveals two distinct peaks of excess frequency per year. In recent years the peaks clearly appeared at the beginning of the rainy season (May-September) and at the onset of the dry and cooler months (November-February).

Etiologic observations

Early investigations in 1959-1961 in the general population revealed the same agents found elsewhere, namely *Shigella, Salmonella* and enteropathogenic *Escherichia coli*. It became evident that *Salmonella* was more prevalent and *Shigella* less prevelant in Costa Rica than in Guatemala.[27] Attempts to link enteroviruses with diarrhea were, as experienced by many authors, futile; however, Coxsackie B viruses were found associated with some acute diarrheas.[32]

In 1969 an explosive regional epidemic of Shiga dysentery of high lethality, spread from Guatemala into the remaining Mesoamerican nations.[2,16] The epidemic reached Costa Rica, but probably due to better sanitary conditions in this country and to well coordinated preventive and treatment measures, it did not progress.[25] Cases were much fewer than in the other countries, and lethality was significantly small. The epidemic became abated and did not reach Panama.

With the characterization of enterotoxigenic *Escherichia coli* and the discovery of human rotaviruses, new studies began in Costa Rica. A long term observation of acute diarrhea cases seen at the outpatient clinics of the National Children's Hospital commenced in February of 1976 and continued until May of 1979. By means of the enzyme-linked immunosorbent assay (ELISA) and confirmation of a subsample by electronmicroscopy,[38] rotaviruses were fonud to be the commonest agents associated with diarrheal disease in Costa Rica.[19] Monthly prevalence ranged from zero to 89%, and the overall mean for the surveillance period was 40.3%. However, the zero prevalence found in one particular month of a particular year probably was due to the small size of the sample examined. Rotaviruses also were detected among hospitalized neonates and chronically malnourished children in whom reinfections were demonstrated.[4] Rotaviruses are ubiquitous and were present each month of the surveillance period, regardless of season. A large outbreak of diarrhea associated with rotaviruses occurred in December, 1976 and January, 1977.[5,7,14,19] Outbreaks also were evident in July-August, 1977; December, 1977; September-November, 1978; and January and May, 1979 (Figure 5). Rotavirus prevalence in non-diarrheic children of the same age and examined at the same time, was less than 5%. Rotaviruses were found in greater frequency during the "winter" or "dry and cold" months (November-February) but also in the "rainy and warm season" (May-September). They were associated with "winter" peaks evident in Figure 4. Epidemiologically, Costa Rican rotaviruses identified in outbreaks belong to type 2.[44]

Rotavirus diarrhea is mainly confined to infants and young preschool children but adults may be attacked. Clinical features basically are those described by others, namely an abrupt onset with watery diarrhea, severe dehydration and vomiting. Red blood cells and leukocytes may be found in the stools of about 20% of the cases. Patients often have fever, but in general, the clinical course is less severe than that of shigellosis.[19]

Regarding enterotoxigenic *Escherichia coli*, studies conducted by INISA and the National Children's Hospital during the warm and "cold"

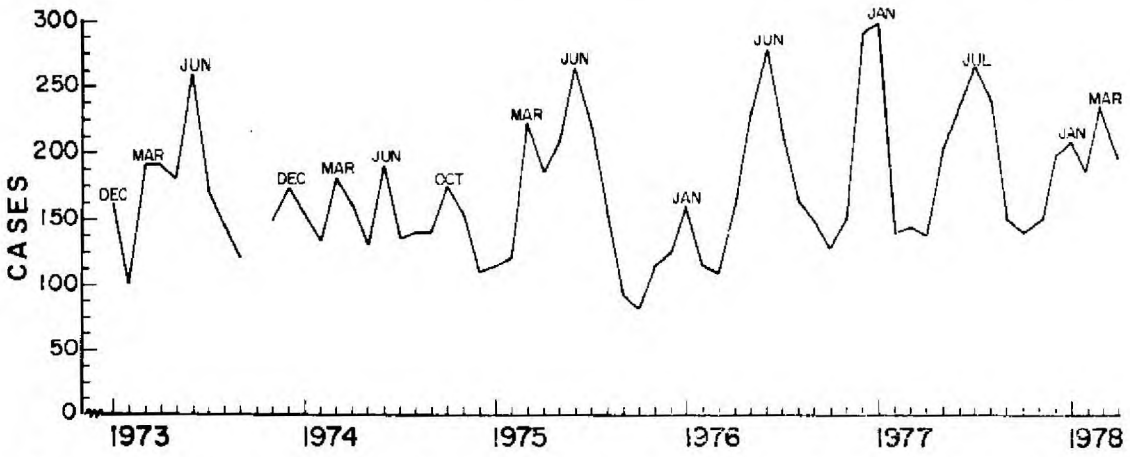

FIG. 4. Cases of acute diarrheal disease attending the outpatient and emergency clinics, National Children's Hospital, Costa Rica, 1973-1978. The two yearly peaks became more evident after 1974 (see text). No data were available for September and October of 1973.

seasons of 1976, revealed a prevalence of 27 to 30% enterotoxigenic strains among hospitalized children with acute diarrhea, and of 4 to 20% in hospitalized matched non-diarrheic cases.[6,37] Stable toxin (ST) producers were twice as common as labile toxin (LT) strains. The greatest difference between diarrheic and non diarrheic children was for ST strains. However, the prevalence of enterotoxigenic strains in children with acute diarrhea upon admission (reflecting the situation in the general population) was one half of that observed among hospitalized children, that is, about 10%. More recently, *Campylobacter* was found in rural infants with acute diarrhea, studied prospectively at INISA (M. VIVES, unpublished). Other pathogenic bacteria are being sought but have not been isolated.

Research on treatment of diarrhea

While prevention of diarrhea is the desired goal, much has been accomplished regarding treatment, as evidenced from the sharp reduction of mortality, especially in hospitals. Stimulated by the encouraging results of oral rehydration as a life saver (see review in reference 10), the positive effect of oral rehydration in the community was demonstrated in a WHO-sponsored field trial in the Philippines.[42] Reexamination of these data, showed that children receiving oral rehydration gained weight at a velocity significantly greater than that of children who were not treated with oral rehydration, although weight gains were lower than those of normally growing children, Table 3.

Studies were carried out in Costa Rica by scientists of the University of Maryland, the National Children's Hospital and the Instituto de Investigaciones en Salud (INISA) of the University of Costa Rica. They demonstrated that: (a) oral rehydration was almost 100% effective and safe under hospital conditions for rehydration of children with moderate and often severe dehydration of rotavirus and bacterial origin;[29] (b) oral rehidration was equally effective for rotavirus diarrhea whether sucrose or glucose are used in the formula;[28] and (c) the scheme of oral rehydration employed for older children was safe and effective to rehydrate neonates[34] and other infants.[36]

Before the advent of oral rehydration, significant advances had been made in Costa Rica re-

TABLE 3

MONTHLY MEAN WEIGHT GAIN (GRAMS) BY DIARRHEIC CHILDREN RECEIVING ORAL FLUID THERAPY, PHILIPPINES, WHO STUDY, 1977

Age months	Philippines OR*	Philippines C**	Reference gain***
0-5	419	288	740
6-11	219	159	400
12-23	243	189	190
24-35	225	191	160
36-47	234	97	160
48-59	247	148	150

* Oral rehydration
** Control without oral rehydrattion
*** 30th. percentile boys, NCHS-CDC

TABLE 4

COST-BENEFIT OF THE NATIONAL PROGRAM OF ORAL REHYDRATATION (NAPOR), COSTA RICA

1. Hospital cost of diarrhea, 1977	$3.500.00
2. Reduction of 80% hospitalizations and 50% outpatients	2.190,000
3. Cost of NAPOR ($174,000 + 58,000)*	232,000
Total savings related to NAPOR	1.958,000
Reduction in total cost = 44%	

* See text
After Mejía (1979).

garding intravenous fluid therapy, with an important reduction in mortality. Adequate supplies of fluids and the necessary equipment were kept in hospitals and many rural health posts and centers, and this in all probability had an important effect in preventing deaths. On the other hand, the greater availability of roads and transport permitted referral of severe cases for proper treatment.

The studies of early 1978 resulted in the adoption of oral rehydration as the first choice for most cases of diarrhea at the National Children's Hospital, and probably caused a further accentuation in the trend of decreasing lethality.[31] Changes in the criteria to evaluate patients upon admission as well as changes in the severity of disease and nutritional status of diarrheic children occurred in the last few years. Nevertheless, case fatality among children receiving oral rehydration (about 90% of cases) and rapid venous therapy (about 10% cases) decreased from 3.0 to 0.5 per 1000 from 1977 to 1979, an 83% reduction.[31] Before 1978, other types of therapy were customary in the Hospital. Probably an improved education of the public, and a better nutritional status coupled with modern hospital practice induced the observed trend.

National Program of Oral Rehydration (NAPOR). Research component

At present, about 150 diarrhea deaths, mainly in infants, occur each year in Costa Rica. Thus, a joint decision was taken by the Ministry of Health and the Social Security System to use oral rehydration on a national basis, and to transfer the technology to the home aiming at preventing or correcting most dehydrated children particularly in rural areas. The decision was spurred

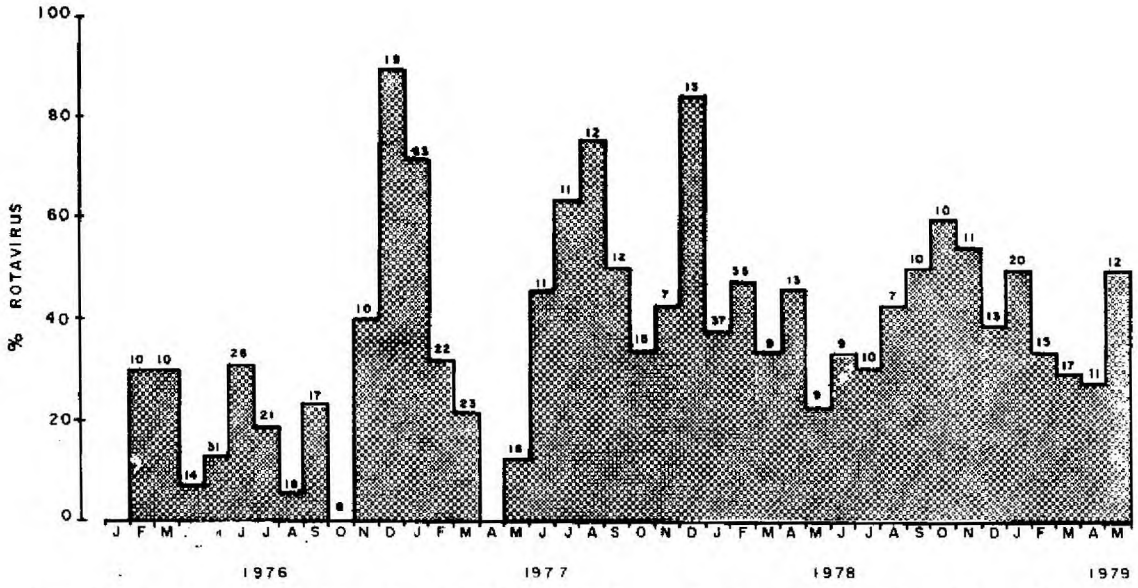

Figure 5. Prevalence of rotaviruses by the ELISA in children under 2 years of age, Costa Rica, February, 1976-May, 1979. Numbers above bars are numbe of children studied. No children were studied in January, 1976 and April, 1977. No positive cases were found among 8 children examined in October 1976. Months, of greatest rotavirus prevalence were December, 1976; January, 1977; July and August, 1977; December, 1977; and October, 1978.

by studies conducted at the National Children's Hospital and at INISA, followed by the creation of a National Comission on Oral Rehydration. Before the technology on oral rehydration could be transferred to the homes, it was necessary to test the capacity of mothers to learn the procedure first at the hospital outpatient and clinic, and then at the health post. Transfer of technology to auxiliary health personnel and mothers was succesful in the hospital [35] and in the field according to an INISA study (P. JIMÉNEZ, unpublished).

Two surveys conducted simultaneously in different parts of the country, one by INISA and the other by the Social Security, revealed the abscense of containers of one liter, while a wide range of "bottles" of various sizes was detected. Such finding precluded the use of the original UNICEF-WHO pack of electrolytes. However, more than 98% of the homes had 8 oz bottles for formula feeding. A new pack was designed at INISA by G. Uriburu containing a corrected concentration of salts for the 8 oz bottles, Figure 6. At present, several million packs of SUERORAL are being distributed by the Social Security, accompanied by: (a) manuals intended for physicians,[33] (b booklets designed for nurses and auxiliary personnel, and (c) leaflets directed to the mothers themselves, with instructions and drawings on the oral rehydration procedure. A "communication scheme for the education component" of NAPOR has been published [28] and is being widely distributed among professionals in Costa Rica.

The plan is to transfer technology to mothers within the next two years. Estimated cost of consultations and hospitalizations for diarrhea in the hospital system during 1977 was 30 million colones ($3,500,000), while the cost of NAPOR is significantly less. For 250,000 preschool children in Costa Rica (1977), 500,000 cases of severe diarrhea could be expected (2 attacks per child per year). These require 3 million packs of SUERORAL (6 packs per case of diarrhea with a cost of 1.5 million colones or $174,000). The cost for audiovisual materials and training of personnel has been estimated in 500,000 colones ($58,000).[23] No cost for delivering the intervention at the community level has been included because the country already has an infrastructure for delivery of primary health care.[41]

The total cost of NAPOR is $232,000 (Table 4) which conservatively will reduce about 80% of hospitalizations and 50% of hospital admissions and consultations. Furthermore, there will be significant savings in terms of infant deaths, and benefits to the nutritional state of the child and wellbeing of the family, not only from the psychologic point of view but from the economic angle as well. NAPOR will be evaluated by INISA as a case of applied research.

Preventive measures. A research effort in promotion of breast-feeding

Costa Rica has not diminished efforts to prevent diarrheal diseases. The programs of water supply, latrines and education continued, now with television and radio broadcasts, and promotion through posters and the press. The coverage of water supply has been extended to the sparse rural population by means of water pumps, initially acquired with an U.S.A.I.D. loan to the Government; coverage will be extended to 95% of that population by 1985.

One aspect that deserves special mention because of its immediate and long range significance for survival of children, is the situation of breast-feeding. In this regard Costa Rica is in a critical position since, accordnig to two nutrition surveys conducted in 1975 and 1978 by the Ministry of Health about 30% of newborn infants were not put at the breast at all. By one month of age, 24% of infants in rural areas had been weaned into formula milk schedules, and by 5 months of age 61% already were weaned, usually with formula (cow's) milk.[1,24] The reasons for the situation probably are many,[1,13] but it might had been related to the common hospital practice of drastic separation of mother and infant *post partum*.

In a long term prospective cohort study of maternal and child health and development in Puriscal, a typical rural mountainous region, INISA is recruiting all cohort infants born in a two year period. About 85% of the infants are born in the San Juan de Dios Hospital under a norm which emphasizes some mother-infant interaction.[17] Mothers and infants are visited immediately upon return to the home in three of the eight districts of Puriscal (Subcohort I). The growth of infants (weight, length and head circumference), their feeding habits, and the general state of health are monitored at least monthly by our team in the three districts. Weight and length, and feeding patern of infants are recorded by auxiliaries and health workers of the Ministry of Health in the remaining five districts.

Preliminary results obtained for all mothers and newborns of subcohort I recruited since September 1979, revealed that almost all infants received the breast in the first few days, 95%

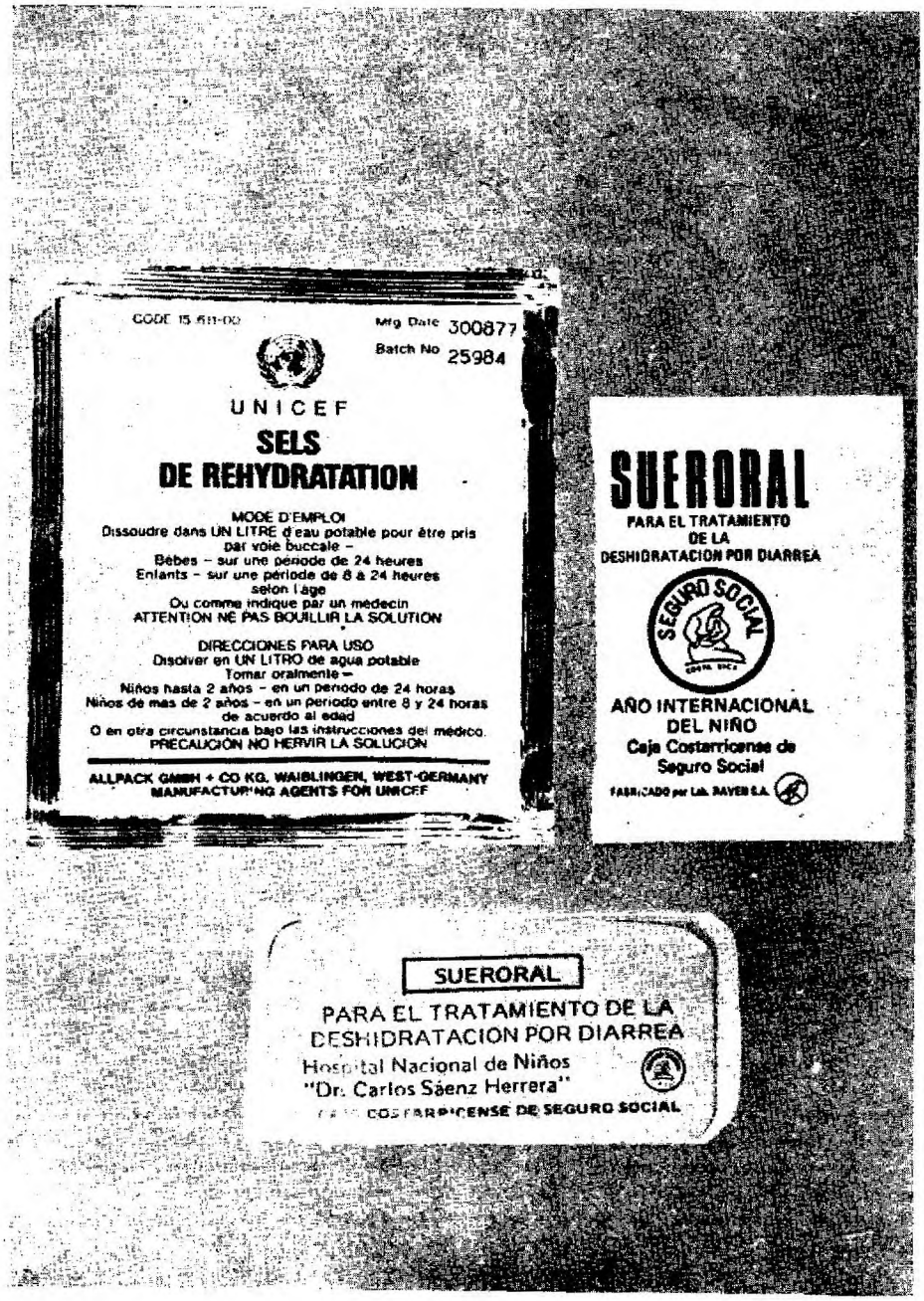

Fig. 6: Packaging of oral rehydration salts. Upper left is the UNICEF-WHO pack for one liter; the others are packs for 8 ounces (240 ml). The pack for 8 oz designed at INISA and manufactured by hand is shown below. Several names (SALUSAL, SALBUENA) were suggested, but SUERORAL, coined by Dr. Edgar Mohs, prevailed. Factory-made SUERORAL packs (upper right), are being distributed nation-wide by the Social Security System and the Ministry of Health. SUERORAL has 2.25 g per liter of potassium chloride and does not have flavoring. The pack has instructions for its administration including advise on when to give water and half-milk.

TABLE 5

BREAST-FEEDING IN THREE RURAL DISTRICTS OF PURISCAL (SUBCOHORT I), 1979-1980, COMPARED TO RURAL COSTA RICA, 1978

Age in months	% At the breast		% Weaned	
	Puriscal*	Costa Rica**	Puriscal	Costa Rica
1	92(95)***	26(76)***	(5)	(24)
2	83(89)	47(72)	(11)	(28)
3	68(84)	40(52)	(16)	(48)
4	61(87)	36(55)	(13)	(45)
5	46(85)	28(39)	(15)	(61)
6	39(80)	28(57)	(20)	(43)
7	30(77)	34(30)	(23)	(70)
8	25(68)	18(39)	(32)	(61)
9	13(69)	13(31)	(31)	(69)

* Cohort study, September 1979-July 1980. Rural communities of less than 500 inhabitants.
** National Nutrition Survey (prevalence study), Costa Rica, 1978. Rural communities of less than 500 inhabitants.
*** Number of infants studied. In parentheses, percentages.

were at the breast by age one month, and 84% by 3 months. Even at 8 months, 68% of infants were being breast-fed, although formula and other supplements had been introduced into the diet of most infants. This is a strikingly different picture from that revealed by the recent nutrition surveys, Table 5.[17] The results observed by our team in three districts were slightly better than those obtained by workers of the Ministry of Health in four other rural districts of the same region. While search for an adequate explanation of the phenomenon observed is sought, we propose that mother-infant stimulation after delivery and the promotion of breast-feeding by the hospital staff must have influenced the change. This proposition is being tested at present. It is important to note that diarrheal disease has been minimal in these rural children during the first six months of life, the attack rate being less than 0.5 episodes per child per semester. Furthermore, no infant deaths have been recorded in the first eleven months of the study; 5 neonatal deaths ere expected according to the 1979 observed national infant mortality figure. The prophylactic effect of human colostrum and milk has been emphasized.[22] Anti-rotavirus factors and antibodies were detected in most colostrum and breast milk specimens of Costa Ricans.[3,39]

Other research efforts

Research on diarrheal disease is conducted mainly at the National Children's Hospital and at the Instituto de Investigaciones en Salud (INISA). It emphasizes the development of measures for control and prevention, with an important component of health services research, specifically the transfer of technology of oral rehydration to the mother and other members in the family in rural communities.

Basic research is conducted at INISA, particularly on the etiology and epidemiology of diarrheal disease and on host specific factors against diarrheal agents. Search for the classical etiologic agents is complemented with investigation of rotaviruses, enterotoxigenic *Escherichia coli, Yersinia, Edwardsiella, Campylobacter* and other vibrios. Furthermore, in specimens negative for the above-mentioned agents, virus-like particles other than rotaviruses and adenoviruses are investigated by immunoelectronmicroscopy, after reconcentration by ultracentrifugation. Preliminary findings have shown coronavirus-like, astrovirus-like and other particles in stools of diarrheic children (F. HERNÁNDEZ, unpublished).

Etiologic findings are correlated with growth performances in order to determine the impact being

of specific diarrheas on nutrition and growth of children. Since oral rehydration is used to treat children in the field, unique data on its effectiveness for treatment of specific diarrheas are being collected.

With reference to host factors, investigation of antibodies to rotaviruses, labile toxin of Enterobacteriaceae and food allergens is under way both in colostrum and in mature milk. Studies are observational but an intervention in a hospital is also being evaluted.

ACKNOWLEDGMENTS

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MATA, L., Perspectiva epidemiológica de la diarrea en Costa Rica. Esfuerzos realizados para su investigación prevención y control. *Rev. Lat-amer. Microbiol.* 23: 109-119, 1981.

RESUMEN: El presente trabajo muestra que la mortalidad debida a enfermedades diarréicas en Costa Rica comenzó a declinar en la década de los años cuarentas. Después de un período estacionario, (1948-1964), la disminución llegó a un nivel de 12 muertes por 100,000 habitantes en 1977.

La primera disminución en mortalidad por diarrea coincidió con reformas sociales e incremento en los ingresos del país. El estancamiento por otro lado se relacionó con inestabilidad social, guerra civil y un crecimiento sustancial de la población. La rápida disminución reciente coincidió con un mejoramiento de los servicios de salud, del ingreso y del nivel de vida de la población. costarricense.

Se presentan datos sobre la etiología y el tratamiento de la diarrea en Costa Rica, así como los avances en la rehidratación oral como medida importante del tratamiento. Diversas investigaciones permiten establecer que los principales agentes etiológicos en niños hospitalizados fueron rotavirus, y en menor grado bacterias. La rehidratación oral demostró ser un procedimiento efectivo para el tratamiento de la deshidratación moderada y severa de origen viral. Otros hallazgos mostraron: la necesidad de incrementar la concentración de potasio en soluciones orales, que la sacarosa y la glucosa son igualmente efectivas y que los neonatos pueden ser tratados con esquemas y soluciones recomendadas para niños mayores.

Finalmente se describen los esfuerzos hechos para prevenir las diarreas a nivel nacional principalmente en áreas rurales. Existe un programa de difusión a través de toda la nación que tiene como objetivo difundir la tecnología de rehidratación oral a madres y otras personas con el objeto de que ésta sea llevada a cabo en el hogar.

A través de un estudio prospectivo de campo de larga duración, conducido por INISA en Puriscal, se demostró un cambio drástico por INISA en Puriscal, se demostró un cambio drástico en el patrón de alimentación al pecho materno. Más del 80% de las madres continuaron dándole pecho a sus niños después del 5o. mes, en contraste con la cifra de 40% registrada en áreas similares por el Ministerio de Salud en 1975 y 1978. El incremento en niños con alimentación con leche materna en la población estudiada, parece estar relacionado con el internamiento y la promoción dentro del hospital. La sobrevida y el estado físico de los niños de la falange fueron mejor que lo esperado para áreas rurales de Costa Rica.

Existe en Costa Rica un programa permanente que se lleva a cabo en el Hospital Nacional del Niño y el Instituto de Investigaciones en Salud. En esta investigación se hace énfasis en la rehidratación oral, transferencia de la tecnología de la misma para ser aplicada en el hogar, promoción de la alimentación al pecho materno y la epidemiología de las enfermedades diarréicas en el área rural.

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