Human Organization, Vol. 55, No. 1, 1996

0018-7259/96/010047-11$1.60/1

Can We Predict What Mothers Do? Modeling Childhood Diarrhea in Rural Mexico

GERY W. RYAN AND HOMERO MARTÍNEZ

In this article we build a decision model to predict how Mexican women treat childhood diarrhea. From ethnographic interviewing, we found that women's beliefs about types and causes of diarrhea, and women's perceptions about different treatments do not uniformly affect behavior. Some beliefs appear to affect treatment choices but others have no noticeable consequences. We also found that beliefs about diarrhea and its treatment varied among community members. Despite this intracultural variation, we built a decision-making model that predicts 84% of an independent sample of reported treatments. The model uses 11 rules. The research has implications for medical anthropology, research methods, and medical intervention strategies.

Key words: decision making, diarrhea, medical anthropology, research methods; Mexico

Social research on illnesses has concentrated on two key questions: 1) How do environmental and economic factors affect patterns of treatment (Bentley 1988; Scrimshaw and Hurtado 1988; Weiss 1988)? 2) How do beliefs, attitudes, or perceptions affect the choice of treatment (Coreil and Genece 1988; Stapleton 1989)?

Researchers generally consider caretakers to be rational decision makers whose knowledge and resources affect their choices. Some researchers (Woods and Graves 1976) state that material and economic factors are central to shaping health behaviors. Others (Fabrega 1974; Kleinman 1980) claim that beliefs (also called "explanatory models") are the strong shapers of treatment practices. For example, in research on diarrhea, two cognitive factors are generally reported to affect treatment behavior: typologies of diarrhea and perceived causes of diarrhea. Kumar *et al.* (1981), Escobar and Chuy (1983), de Zoysa *et al.* (1984), Green (1985), Nichter (1988), and Weiss (1988) have shown how complex typologies of diarrhea influence treatment behavior around the world. Nations (1982) and Kendall *et al.* (1984) have demonstrated how perceptions of causes affect therapeutic approaches.

Most investigators consider both explanatory models and environmental and economic constraints. For example, Young (1980) showed that an individual's beliefs and economic factors interact when predicting treatment behavior in a Mexican village. He tied people's perceptions of the gravity of an illness and the likelihood of a cure to the availability of money and transportation. Other researchers have found that beliefs about types and causes of illness played a significant role in health-seeking behaviors but only in relation to other non-cognitive influences (Scrimshaw and Hurtado 1988; Smith *et al.* 1993).

Many ethnographic studies of diarrhea treatment examine the range of beliefs and management practices in a community or culture. Such studies are a necessary first step in answering the question "Why do caretakers do what they do?" However, they are often high on descriptive power and low on predictive ability. Ethnographic studies provide investigators with information to pose specific hypotheses about the causal links between beliefs and behavior. These hypotheses need to be formalized so that data can be collected and the hypothesis tested.

Recently, investigators have suggested using decision-making techniques to better model the relationship between beliefs and behaviors (Mathews and Hill 1990; Pelto and Pelto 1990; Scrimshaw and Hurtado 1988; Young 1981b). Young (1980) successfully predicted reported treatment behavior using a few decision rules. While examining therapeutic choices in Mexico, he asked three questions: 1) What

Funding for this project was provided to Gery Ryan as part of a larger grant made to the University of Florida Center for Latin American Studies by the Tinker Foundation. *Dr. Gery W. Ryan can be contacted at Fieldwork & Qualitative Data Laboratory, Department of Psychiatry & Biobehavioral Sciences, University of California, Los Angeles, C8-887 NPI, 760 Westwood Plaza, Los Angeles, CA 90024-1759, e-mail: <gryan@ucla.edu>. Dr. Homero Martínez can be contacted at Grupo Interinstitucional de Investigación en Sistemas de Salud IMSS-SSA, Centro Médico Nacional Siglo XXI, División de Investigación en Epidemiología y Servicios de Salud, Bloque B de la Unidad de Congresos, 4 Piso, Av. Cuauhtémoc No. 330, Col. Doctores, México 06275, D.F., México, e-mail: <homero@profmexis.dgsca.unam.mx>.* *The authors wish to thank the field staff at the Solís Valley Rural Research Center, as well as the mothers who participated in the study. We also express our gratitude to Pertti Pelto, Carl Kendall, Peter Killworth, Susan Weller, and anonymous reviewers for their helpful comments on earlier versions of the paper. We would especially like to thank H. Russell Bernard for his insights into the decision-making process and his suggestions for directions of future research. This article is derived from a paper awarded the Society for Applied Anthropology Peter Kong-Ming New Prize in 1991.*

are the alternative cures that the group sees as open to them? 2) What are the criteria they use in selecting alternatives? 3) What is the decision process, i.e., what principles do people use to manipulate the information available?

In this study we apply a decision-making model to diarrhea management in a rural community of Central Mexico. We base our model on ethnographic interviews about past illness episodes that we conducted with local mothers. We incorporate into the model community intracultural variation which we found in our interviews. Further, we test the model's predictive ability by trying it on an independent sample of reported treatment behaviors.

Background

Diarrhea is one of the world's main killer of children. It is estimated that diarrhea caused 3 million deaths in 1990 (UNICEF 1993). Even cases that are not life threatening retard the physical growth of children (Black *et al.* 1984; Martorell *et al.* 1975; Mata *et al.* 1972). In Mexico, for example, diarrhea has a significant effect on weight and height of children, mostly in the first 18 months of life (Martínez 1988). In the Solís Valley of Mexico, where we conducted fieldwork, diarrhea and poor nutrition contribute heavily to children's low weight and height.

Description of the Study Area

The Solís Valley is a rural agricultural area in the central valley of Mexico, 170 kilometers northwest of the capital city. The floor of the valley is 2,400 meters above sea level. Winters are cold and dry, while summers are warm and rainy. The valley hosts a group of villages ranging in population from 800 to 1,900. Agriculture is the main economic activity of the people. Cultivation of maize depends on water from the Lerma River. The highly polluted waters of the river are used to irrigate the fields and are also a drinking source for animals, whereas drinking water for human consumption comes from wells. There is no sewage disposal in the area. These conditions are typical of many rural communities throughout the highland plateau of Mexico, and contribute to a high level of environmental contamination with human feces. Diarrhea is a common problem, particularly for children. Previous studies in the area show that marginal malnutrition affects about 60% of the under 5-year-old population, although severe malnutrition is rare (Allen *et al.* 1987).

We collected the data for this study in San José a mestizo village of 1,800 people in the center of the valley. San José was part of a valley-wide project, funded by the Applied Diarrheal Disease Research Project (ADDRP), on childhood diarrhea. The aim of the project was to find the food and drink that are both good for a child and accepted by mothers for use during acute diarrheal episodes among children. The project examined the factors that predict caretaking behavior, and researchers hoped to use this information to develop more effective intervention programs (Martínez 1990).

Mothers in San José have a lot of experience treating childhood diarrhea. They respond to the illness with a variety of caretaking behaviors. We refer to a single behavioral responseto an illness episode as a treatment. The most common treatments modalities are liquids such as herbal teas (*tes*), rice

Table 1. Reported Causes of Childhood Diarrhea[1]

Causes	Frequency	Percentage
Dirty food (*comida sucia*)	75	53
Empacho	59	42
Food the child didn't like	46	32
Heat (*por calor*)	27	19
Teething (*por los dientes*)	20	14
Green fruit	10	7
Parasites (*parásitos*)	8	6
Other (*otra*)	29	20

[1]Percentage of mothers who said that a particular item caused diarrhea in their children (n=142) (May include more than one answer).

Table 2. Reported Types of Childhood Diarrhea[1]

Types	Frequency	Percentage
Bloody (*con sangre*)	65	46
Yellow (*amarilla*)	55	39
Green (*verde*)	54	38
Watery (*aguada*)	33	23
Empacho	21	15
With mucus (*con moco*)	16	11
Other (*otra*)	72	51

[1]Percentage of mothers recognizing different types of diarrhea (n=142) (May include more than one answer).

water (*atole de arroz*), and carbonated beverages (*gaseosas*). Homemade sugar-salt solutions (*suero oral*) are also given. Mothers also manipulate their infant's body by pinching the child's back (*pellisque*), placing holed paper on the child's abdomen (*papel estillido*), or massaging the child (*masaje*) to cure diarrhea. These treatments are common in other parts of Mexico (Vega *et al.* 1979). Women use both prescription and nonprescription drugs (*pastillas*). (Doctor's prescriptions are not necessary for getting drugs at a pharmacy. Informants noted, "If you can say it, you can buy it.") Mothers may seek advice from formally trained medical personnel including private physicians (*doctor privado*), community health workers (*auxilliares*), and government sponsored clinics (*unidades*). These treatment modalities are not mutually exclusive.

To facilitate our analysis, we categorized responses to diarrheal illnesses into 1 of 7 treatment modalities. These included: teas, carbonated beverages, rice water, sugar-salt-solutions (SSS), pills, physical manipulations, and formally trained medical personnel. Our data show that women in San José use from 1 to 7 of these different treatment modalities in dealing with a single diarrheal episode.

From previous research (Martínez *et al.* 1991), we know that mother's throughout the valley perceive diarrhea as coming from dirty food, teething, *empacho* (the sticking of food in the stomach or intestines), heat, green fruit, and worms (Table 1). Most women have heard of *microbios*, but they do not spontaneously associate microbes with diarrhea. Women in the Solís Valley differentiate among several types of diarrhea. They distinguish between bloody (*con sangre*), green (*verde*), yellow (*amarillo*), white (*blanco*), mucosal (*con moco*) and diarrhea caused by *empacho* (Table 2). *Empacho* shows that concepts of cause and type are not necessarily exclusive. For a review of this folk illness, see Weller (1991), Trotter (1989), and Smith (1993).

Study Design

The immediate goal of the study was to understand better how mothers decided to treat episodes of childhood diarrhea in San José. From previous studies (Martínez 1988, 1990; Martínez *et al.* 1991), we know how mothers in Solís classified illnesses and how they understood the causes, symptoms, and treatments associated with childhood diarrhea. We hoped that by understanding how mothers made choices about treatments, we could provide recommendations for future intervention programs throughout the valley. We wanted our model to predict not only what treatment modalities mothers used or didn't use, but also the order in which they started each modality. We realized that laypeople often use different treatment modalities simultaneously. We chose, however, to only examine the order in which they started treatments to simplify our analysis. In hindsight we would have learned more if we collected data on the duration and overlap of treatments.

For the project, it was important to understand why mothers gave or did not give sugar-salt-solution early in the treatment sequence. We decided to model the seven treatment modalities mentioned above.

We built and tested our decision model in three steps. In the first step, we used open-ended questions to elicit the decision criteria from a group of informants. In the second step, we used the same ethnographic information to build a formal model. The model represented our hypotheses about the interaction between the elicited decision criteria and reported caretaking behaviors. Finally, we tested the model's ability to predict an independent sample of mothers' reported treatment behaviors. We refer to the sample on which we built the model as Sample A. We called the second sample, on which we *tested* the model, Sample B.

Step 1. Elicitation of Decision Criteria

In our ethnographic interviews we specifically explored the decision criteria that mothers used to select among alternative treatments. Since we planned to build an aggregate model of the community's treatment behaviors, we wanted to elicit the fullest possible range of decision criteria from our informants. This mandate presented us with two problems: 1) How to select a sample of informants who would represent the widest variation in the community; and 2) How to elicit the most complete list of decision criteria from each informant.

Selection of Sample A

From previous studies, we knew that some women in San José have traditional views about health and illness, while others seem more knowledgeable about the biomedical model. To capture this variation in medical beliefs, we first created a true/false test of 45 questions about general medical knowledge. We compiled a list of potential questions by asking doctors, nurses, and nutritionists who were working on the Solís Valley project to suggest questions that they might put on a test of medical knowledge. Of the questions suggested, we pretested 50 on 10 women from another village to see if they understood the wording. We dropped 5 of the questions and made appropriate word changes to a few of the others.

We administered the true/false test to 40 mothers in San José who had children under 5 years of age. We selected women we found at home over a week-long period in different parts of the village during different times of the day.

The responses of the 40 women were analyzed using *cultural consensus modeling*. Cultural consensus modeling allowed us to: a) establish that the women's responses demonstrated a cultural consensus (Borgatti 1990; Romney *et al.* 1986); and b) identify those women whose answers in the interviews most closely matched the *cultural consensus*.

Of the original 40 women, we selected a sample of 20 for *developing* our predictive model. This was a purposive sample, consisting of 8 women who most closely matched the "consensus model" in the 45 questions, plus 6 of the most "traditional" and 6 of the "most modern" respondents from the group of 40 women. We defined mothers as *modern* and *traditional* based on how well or poorly they agreed with the doctors and nurses who had formulated the questions. We considered women to be modern if they agreed a lot with the our biomedical experts and traditional if they did not. We hoped that such a sample would help us develop a model that would predict the reported behavior of all mothers in the community. We refer to this sample as Sample A.

Data Collection in Sample A

We sought out and conducted ethnographic interviews with each of the selected women. First, we asked mothers about their treatment behavior during their child's most recent episode of diarrhea, as defined by mothers. Informants described what they did in their own words. We recorded what treatments they used and the order in which they had initiated each treatment (first, second, third, etc.). We used a checklist of treatments to probe for any treatments informants might have forgotten. Finally, we renarrated the order of treatments back to the informant to confirm if we had correctly recorded their stories.

After recording a mother's reported behavior, we asked her to tell us why she had decided to use these particular treatments. We took notes during the open-ended interview and recorded any decision criteria that the mother mentioned. To probe for additional criteria, we asked mothers why they had decided against using other treatments. We also we asked mothers how the latest episode of diarrhea had varied from previous episodes and if they had done anything different this time. If so, we asked why (Gladwin 1989).

After our first interview (Sample A), we posited several rules that appeared to govern treatment behavior. We tested these potential rules on the next informant by asking her about these specific beliefs or illness conditions. We continued this process of eliciting rules and checking them on subsequent informants. By the end of our twelfth interview, we noticed that we were not eliciting any more new decision criteria. We continued, however, to interview the remaining mothers in our sample.

Since we had not asked the first mothers we interviewed about decision criteria mentioned by later mothers, we knew that our data would be incomplete. We had anticipated returning to all 20 women in our sample to administer a formal (close-ended) interview schedule about the previously reported illness episode. This way, we would be sure to have the same information from all the mothers.

We created the formal interview schedule by reviewing the list of decision criteria and potential rules generated from the informal interviews. For example, we noted that some mothers had told us they had used a particular treatment because it was the "best" treatment for diarrhea. We decided to include questions about treatment preference in the formal interview. We asked mothers which of 6 treatments they considered the "best" remedy. (We did not include the option of seeking a doctor because we were worried that the option would bias the elicitation of other preferences.) This was a hypothetical question and was not based on any particular diarrheal episode. We noted the selected treatment and repeated the question with the remaining remedies until we got a complete ranking.

After completing the informal and formal interviews, we reduced Sample A to 17. We dropped 2 of the 20 women from the sample because the last case of diarrhea they treated occurred over 3 months ago. We were unable to complete all the ethnographic interview with 1 other woman.

Step 2. Formalization of a decision model

We drew on information from mothers in Sample A to construct a tentative decision model which linked together the decision criteria most important in accounting for mothers' sequences of reported treatment. With an expert system shell (a computer program), we modified the model until we were satisfied with how well it *postdicted* our informants' reported behavior. We expected our model's postdictive accuracy rate to be relatively high but not perfect. On the one hand, the model is a simplistic representation of criteria that account for aggregate behavior patterns and should contain errors. On the other hand, since we had used the data from Sample A to build the model, the model should more or less accurately postdict those same data. The model represents a set of hypotheses about the factors people consider when selecting treatments.

Step 3. Testing the Predictive Power of the Decision Model

Once our model was complete, we tested its *predictive* power on a second independent sample of women, called Sample B. Gladwin (1989) suggests that a second sample test is ideal.

Selection of Sample B

Sample B comprised a selection of 20 mothers from San José. As in Sample A, we interviewed informants over a two week period in different parts of the town and at different times of the day. We interviewed the first 20 women we encountered who had children under 5 and had treated a case of diarrhea in the last 3 months. None of the mothers had been through the (possibly contaminating) exercise of model building with us.

Data Collection for Sample B

As we did in Sample A, we first asked each mother about what she did the last time her child had diarrhea. We used the same checklist of treatments to help mothers remember treatments they might have forgotten and we renarrated the treatment sequences back to each mother to confirm the order of each treatment's use. After recording each mother's reported behavior, we used the same close-ended interview schedule about decision criteria that we had used on Sample A.

Calculation of Model's Predictive (and Postdictive) Power

We used the data collected from the 20 women in Sample B to test the *predictive* power of our model, whereas we used the data from Sample A to test the *postdictive* power of our model. To avoid bias, we programmed a computer to classify cases in in a "blinded" fashion, based on the decision rules of our model. The model predicted a sequence of treatments for each woman. We compared the model's predicted sequence with each woman's reported treatment sequence. When the predicted sequence did not agree with the reported sequence, we considered the discrepancy to be an error in the model's predictive capability. We expected the discrepancies between the predicted and the reported treatment sequences to be minimal. Moreover, we expected our model to predict the reported behavior at better than chance levels.

Calculating the discrepancy between reported and predicted sequences is difficult. For example, we needed to measure the discrepancy between a report by a mother of using: a) a tea, b) a pill, and c) sugar-salt-solutions (in that order); and the model's prediction of: tea, sugar-salt-solutions, and seeking help from medical personnel (in that order).

To simplify the comparison, we forced our model to predict the same number of treatments as each mother reported. If a mother reported using five different treatments, our model made predictions about the five treatments and the order in which the mother used them. We wanted our model to predict what treatments the mothers used and did not use and the order in which mothers used them. We calculated a general accuracy measure that ignored the ordering of treatments, and a specific measure that examined how well the model predicted exact treatment order.

In the general measurement, we considered two types of errors. *Errors of omission* were those where the model failed to predict that the mother used a particular treatment. In our example above, the model fails to predict that the mother used a pill. *Errors of commission* were those where the model predicted that the mother would use a treatment but in fact did not. In our example, the model predicts that the mother will seek help from a private doctor when she does not. We kept track of the different types of errors for each treatment to better understand the strengths and weaknesses of the model.

To calculate the more specific measure of accuracy, we examined each position in the recalled and predicted sequences and determined if they matched. In our example above, only the first treatment, tea, matches exactly what the mother reported doing and what the model predicted she would do. The large number of possible sequence permutations makes achieving a high level of specific-order accuracy difficult.

In order to determine when the model was accurate enough to justify its use, we had to compare measures of accuracy to some standard. One way of doing this was to compare the measures of accuracy with what we expect to get by *chance* (Weller *et al.* 1996). We used our knowledge of each sample's distribution of treatments to calculate the probabilities of correctly predicting treatments just by chance. In the case of the general measure of accuracy, we first counted the number of times mothers used and didn't use a particular treatment. For each treatment modality, we then calculated the number of times that we expected to be correct if we randomly and proportionately classified the cases into *used* and *didn't use*

Figure 1. Overall Decision Model

Rule 1			
IF	child has blood stools OR child has swollen glands OR child is vomiting		
THEN	take child to doctor		
Rule 2			
IF	diarrhea is caused by empacho		
THEN	give physical treatment		
Rule 3			
IF	previous rules do not apply OR there is no cure with the empacho treatment		
THEN	give the highest preferred curing treatment that meets constraints*		
Rule 4			
IF	previous treatment did not stop diarrhea		
THEN	compare the two highest treatments of remaining options		
	4.1	IF	one is a curing remedy AND meets its constraints
		THEN	give this treatment
	4.2	IF	both or neither are curing remedies AND each meet their respective constraints
		THEN	give the highest ranked preference
Rule 5			
IF	the previous treatment did not stop the diarrhea AND the episode is less than 1 week long		
THEN	repeat Rule 4		
Rule 6			
IF	the episode has lasted more than 1 week		
THEN	take the child to a doctor		

*Only sugar-salt-solutions or medications have constraints. These constraints are listed in Figure 2.

Figure 2. Constraints on Remedies

Sugar-salt-solution	
IF	you know how to make ORS AND your child will drink ORS
THEN	give ORS
Pill or Liquid Medication	
IF	you know a medication that works for diarrhea AND you have it in the house
THEN	give the pill or liquid medication
IF	you know a medication that works for diarrhea AND it is cheap AND it is easy to obtain
THEN	give the pill or liquid medication

categories. Finally, we compared observed levels of accuracy with levels of accuracy we expected by chance. For each treatment modality, we report: a) the model's ability to postdict or predict better than chance; b) the ratio of observed accuracy to accuracy levels obtained by chance; and c) the probability of obtaining such observed levels of accuracy by chance alone.[1]

To calculate the model's prediction of all treatment modalities, we averaged the measures of the chance across all seven different modalities. We used calculations similar to those in the general case to assess the chance of the model correctly guessing exact treatment orders. Again, we compared our measures of accuracy with those expected by chance.

The Model

The formal and informal interviews in Sample A suggested several patterns. We observed that certain physical symptoms warrant particular treatments while other symptoms are more ambiguous. We found that women must meet certain *constraints* (i.e., conditions that might otherwise prevent use) for some remedies but not others. For example, mothers had to meet constraints associated with sugar-salt-solution or medications but were less constrained by other remedies. The data suggested that the order in which women administer treatments depended on two factors: their faith in the treatment's efficacy and their understanding of the treatment's function. We noticed that women varied in their hierarchy of treatment preferences and whether they considered specific treatments to have curing or simply palliative functions. Individual perceptions of treatment efficacy appeared to influence which treatments women used first, second, and third. We tried to incorporate these observations into a single decision-making model. Figures 1 and 2 show the model that we developed to explain women's sequential treatments of childhood diarrhea.

Model Interpretation

Read the model as follows: Mothers (as an aggregate) first consider the severity of the illness. They consider bloody stools, swollen glands, and vomiting to be serious illnesses. If the child has any of the three symptoms, mothers seek advice from a doctor. Otherwise, mothers decide if the diarrhea comes from *empacho*. If so, the appropriate treatment is some kind of physical manipulation. If it does not come from *empacho*, or if the *empacho* treatment fails, then mothers use additional rules to choose other treatments. They first try their "highest preferred" curing treatment that meets the treatment's particular constraints. If the first treatment slows stool output, they stop. Otherwise mothers compare the "two highest preferred" treatments that remain untried. If one remedy is for curing, and it meets its constraints, they try it. If both or neither are cures, they try the highest preferred remedy that meets all the constraints. Lastly, they repeat the previous rule until runny stools stop or the episode has lasted more than a week. If the latter, they take the child to a doctor.

Model's Postdicting and Predicting Ability

Tables 3, 4, and 5 show our model's postdictive and predictive ability. Table 3 shows that when we tested our model on Sample A, the model made 13 errors while trying to predict 119 possible treatments (17 cases @ 7 treatments per case). This translates into a general postdictive accuracy rate of 89%. That is, on average, the model correctly postdicted whether or not a mother used a particular treatment modality 89% of the time. The model was better at postdicting whether or not women used mineral water, a doctor, and sugar-salt-solutions than it was at postdicting the use of teas or rice water. Except for pharmaceutical products, the model postdicts all treatment modalities at above rates of 80%. All postdictive accuracy rates are significantly better than chance.

Table 4 shows that the model postdicted exactly at what point a mother would use a particular treatment 36% of the time. This is 31% better or over five times greater than

Table 3. General Accuracy Measures by Treatments in Sample A and Sample B

Treatements	Freq.	Errors: Omissions (#)	Errors: Commissions (#)	Correct (#)	Accuracy Measures: Correct (%)	Correct by Chance (%)	Better than Chance (%)	Observed to chance ratio	Probability as good by chance alone
Sample A (N=17)									
te	15	0	1	16	0.94	0.79	0.72	1.12	0.007
atole	13	1	1	15	0.88	0.64	0.67	1.38	0.022
pastilla	8	1	4	12	0.71	0.50	0.41	1.41	0.044
sidral	8	0	0	17	1.00	0.50	1.00	1.99	0.000
médico	5	1	0	16	0.94	0.58	0.86	1.61	0.010
suero	8	2	1	14	0.82	0.50	0.65	1.64	0.003
físico	4	1	0	16	0.94	0.64	0.84	1.47	0.022
Total	61	6	7	106	0.89	0.59	0.73	1.50	
Sample B (n=20)									
te	17	2	0	18	0.90	0.75	0.61	1.21	0.046
atole	14	1	1	18	0.90	0.58	0.76	1.55	0.002
pastilla	12	3	3	14	0.70	0.52	0.38	1.35	0.113
sidral	9	0	4	16	0.80	0.51	0.60	1.58	0.012
médico	8	0	2	18	0.90	0.52	0.79	1.73	0.001
suero	6	1	2	17	0.85	0.58	0.64	1.47	0.002
físico	5	1	2	17	0.85	0.63	0.60	1.36	0.004
Total	71	8	14	118	0.84	0.58	0.62	1.45	

anticipated by chance. As Table 4 shows, the model was better at postdicting treatments given first (65%) and second (47%) than it was at postdicting treatments given later in the sequence.

We used independent Sample B to test the model's predictive power. On Sample B, the model had a general predictive accuracy rate of 84%. This was 62% better or almost 1.5 times greater than chance. As in Sample A, the model is better at predicting the use or nonuse of mineral water, sugar-salt-solutions, or a doctor. Except for pills, all predictive accuracy rates are significantly better than chance.

Table 5 shows that overall the model predicted the exact order in which the treatment was given 18% of the time. This is roughly 13% better or over 3 times greater than expected by chance. Like Sample A, the model is again strongest in predicting the exact order of first treatments used (35%). Despite its overall accuracy, the model performs less than adequately in predicting the exact treatments used first and second.

Discussion

Our model is as accurate as other decision models that predict treatment behavior. Young (1980) examined how people in a rural Mexican community choose one of four possible ways to treat an illness. He used 9 decision rules to model people's initial choice of treatment. Sometimes the selected treatment failed, and people had to make another choice. Young used 11 rules to model people's second choice. Young's two-stage decision model predicted 95% of reported behavior for the first stage and 84% for the second stage. Mathews and Hill (1990) used 9 rules to predict six treatment modalities in Costa Rica.

Weller *et al.* (1996) reassesses the Mexican and Costa Rican models and compares their predictive power to chance. She

Table 4. Sequence Accuracy Measures (Sample A, N=17)

Treatments	Position in Sequence: 1	2	3	4	5	6	7	Total
Observed Frequencies								
te	11	4	0	0	0	0	0	15
atole	0	6	5	1	1	0	0	13
pastilla	2	2	1	2	1	0	0	8
sidral	0	0	3	4	0	1	0	8
médico	1	0	1	0	1	2	0	5
suero	1	2	2	2	1	0	0	8
físico	2	1	0	0	1	0	0	4
Total	17	15	12	9	5	3	0	61
Exact Hits as Predicted by Model (Sample A, n=17)								
te	6	2	0	0	0	0	0	8
atole	0	2	1	0	1	0	0	4
pastilla	1	2	0	0	0	0	0	3
sidral	0	0	0	0	0	0	0	0
médico	1	0	0	0	0	0	0	1
suero	1	1	1	1	0	0	0	4
físico	2	0	0	0	0	0	0	2
Total	11	7	2	1	1	0	0	22
Accuracy measures								
% of observed	0.65	0.47	0.17	0.11	0.20	0.00	0.00	0.36
% expected by chance	0.49	0.23	0.15	0.09	0.02	0.02	0.00	0.07
% better than chance	0.31	0.31	0.02	0.02	0.18	-0.02	0.00	0.31
Observed : chance ratio	1.32	2.04	1.11	1.19	10.70	0.00	n.a.	5.15

found that Young's four treatment options could be predicted by chance 59% of the time. She notes that Young's accuracy rate was 88% better than chance (1.61 times better). In her reexamination of the Mathews and Hill data, she found that treatment behavior could be predicted by chance 23% of the time. Although Mathews and Hill reported an accuracy rate of only 62%, Weller shows that this is still 51% better than, chance (2.21 times better). In her own study of treatment choices in Guatemala, Weller developed a decision model that predicts 48-49% of the cases, but only performed 7%-9% better than chance. Our predictive accuracy is slightly higher than that of Mathews and Hill, and slightly less than Young's. In any case, we know that it predicted significantly better than chance on all treatment modalities except for pharmaceutical products.

The predictive accuracy of our model suggests that we are explaining at least some of the variation in mothers' reported treatment behaviors. The model explains aggregate patterns and only approximates how individual caretakers decide how to manage diarrheal illnesses. The importance of the model is not that it represents exact cognitive processes. Rather, it depicts the interaction among cognitive and non-cognitive factors to predict reported behavior.

This study provides insight into several interesting questions. At the local level we wanted to know, "What does the model tell us about the illness management of childhood diarrhea in San José?" and "What does the model suggest for program interventions?" At the theoretical level, we can ask "What does the model suggest for improving our understanding of how

Table 5. Sequence Accuracy Measures (Sample B, N=20)

Treatments	Position in Sequence 1	2	3	4	5	6	7	Total
Observed Frequencies								
te	9	5	2	0	1	0	0	17
atole	3	1	6	4	0	0	0	14
pastilla	6	4	1	1	0	0	0	12
sidral	0	3	4	1	0	1	0	9
médico	1	1	1	2	2	0	1	8
suero	0	1	1	2	1	1	0	6
físico	1	1	0	1	2	0	0	5
Total	20	16	15	11	6	2	1	71
Exact Hits as Predicted by Model (Sample B, n=20)								
te	2	0	1	0	1	0	0	4
atole	1	0	0	0	0	0	0	1
pastilla	3	0	2	0	0	0	0	5
sidral	0	0	0	0	0	0	0	0
médico	0	0	0	0	1	0	0	1
suero	0	0	0	1	0	0	0	1
físico	1	0	0	0	0	0	0	1
Total	7	0	3	1	2	0	0	13
Accuracy measures								
% of observed	0.35	0.00	0.20	0.09	0.33	0.00	0.00	0.18
% expected by chance	0.46	0.19	0.21	0.10	0.04	0.01	0.00	0.06
% better than chance	-0.19	-0.24	-0.01	-0.01	0.31	-0.01	0.00	0.13
Observed : chance ratio	0.77	0.00	0.95	0.95	9.37	0.00	0.00	3.28

laypeople manage illnesses?" And from a methodological standpoint, we can ask "How could we improve our techniques for building more predictive models?"

What Have We Learned: Illness Management in San José?

The process of collecting ethnographic data, building a model, and testing it taught us that mother's reported behavior is guided by several interrelated criteria. We found that under certain conditions, mothers resorted to particular kinds of treatments. That is, mothers acted as if they were following a condition rule. At other times, however, mothers' acted as if their behavior was impeded by some condition. We refer to such conditions as *constraints*. The ordering of treatments depended on how mothers perceived both the efficacy and function of each of the treatment modalities.

Conditional Rules

Mothers believe that certain conditions warrant particular treatments. Rule 1 applies to severe conditions. If the child has bloody stools, swollen glands, or is vomiting, then a woman seeks medical advice. Other studies on diarrhea have reported increased health seeking behaviors for severe signs. Mothers also seek medical assistance if the diarrhea continues for more than a week (Rule 6). A recent study of reported treatment behavior in Honduras found that caretakers were nearly twice as likely to consult someone (hospital, health center, or other) if the diarrhea had lasted for more than three days or if the child was vomiting (DeClerque *et al.* 1992). In a study in India, researchers found that the presence of blood was associated with an increase in the number of medical treatments given to a child, whereas duration was associated with whether a mother made a medical visit (Bentley *et al.* 1992).

Rule 2 shows how a particular belief affects behavior. Some mothers believe that diarrhea results from a blockage in the stomach or intestines. The condition, known as *empacho*, requires a treatment designed to free the digestive system of obstructions. Under such conditions, women will treat the illness with massages, purgatives, and other physical remedies. In Nicaragua, 82% of mothers recommended using purgatives for *empacho* (Smith *et al.* 1993).

Our decision model does not assume that all beliefs affect behavior. During the process of eliciting rules, informants listed criteria they perceived as using to select among treatment alternatives. For example some informants claimed that stool color was such a criterion. When we examined our data from Sample A, however, we found that stool color failed to postdict treatment behavior. We obtained similar results for categories of illnesses based on causation (such as teething or eating green fruit). As a result, we omitted stool color (and categories based on causation) as an important criteria in our model. On the other hand, we incorporated the belief in *empacho* because it did postdict behavior.

Constraints

Women must meet certain conditions or constraints to use some remedies. The model accounts for such restrictions in Rule 3. Only two of the eight treatments have important constraints associated with them. Figure 2 shows the restrictions on sugar-salt-solution and medications. To use sugar-salt-solution, mothers must know how to make the proper solution. The child must also be able to drink it. For women to use a pill or liquid medication, they must know one that works for diarrhea. If they do not have the item in the house, it must be easy to get and inexpensive. For instance, we were concerned that asking mothers "Did you have enough money at the time to buy such a medicine?" (referring to pills or liquids from pharmacies) would not provide accurate answers. The local health auxiliaries with whom we were working also considered this question too intrusive.

Herbal teas and rice water, because they are cheap and easily obtainable, had no constraints associated with them. Surprisingly, we found no particular constraints on seeking advice from medical personnel. To most women, childhood diarrhea is not a serious enough illness to require special medical treatment. They feel that diarrhea is only serious when the child vomits, has swollen glands, or bloody stools, in which cases, they believe the child has some other illness called "vomiting," "swollen glands," or "dysentery." Since these illnesses are more serious, mothers seek medical help regardless of the cost. "Medical personnel" also includes a range of options, from the expensive private doctor to free public health clinics. (Of course, mothers incur transportation and time costs to attend public clinics. These costs, however, are minimal in comparison to those of consulting private doctors.) Other researchers have found similar results (Oths 1994).

Ordering Factors

Rule ordering is crucial for predicting what remedies women give their children. If there were no ordering procedure, many remedies would pass their respective constraints and we would predict that women would use all the remedies. In fact, women do not use all the remedies. They use remedies sequentially. Once they stop the watery stools, they stop treatment.

Predicting the order in which mothers apply remedies involves two variables. Not surprisingly, a mother's ranking of what she considers the best remedies increases our ability to predict the order of application. Young (1980) used the term *faith*, while economists and market researchers refer to *preference*. The ranking, however, depends on whether or not the mother believes that a particular remedy cures diarrhea, i.e., stops stool output, or is simply something that is good for the child while he or she is going through the illness. Palliatives can either act as sustenance or as rehydration fluids (where women do not see rehydration as part of the cure). Rule 4 says that women will first use a remedy that they believe stops or cures diarrhea. If a remedy is only palliative (nutritive or rehydrating), then women use it after a curing remedy. These ordering principles account for why some women try pills before tea, and others try tea first. Women who think teas stop diarrhea are more likely to use teas earlier in the process than women who think teas are only good for palliative purposes.

Intracultural Variation

Our model incorporates intracultural variation in several ways. Some women in the community believe that *empacho* causes diarrhea while others do not. Rule 2 does not affect women who don't believe in *empacho* at all. Those who believe in *empacho* only respond if they think that *empacho* is the cause of that particular illness episode. It may turn out that only a minority of the population hold the view in San José. We incorporated the rule into the model because there is a strong association between the belief in *empacho* and the use of treatments that involved physical manipulation or use of purgatives. Since these treatments are hazardous to children, they warrant inclusion.

Much of the variance in choice of treatment comes from intracultural variation in either what women consider the "better" remedies or what they consider the function of the treatment to be. Some women think that tea is better than sugar-salt-solution, while others think the reverse. Some women think that rice water stops diarrhea, while other only think that it is "good for the child." The model allows for this intracultural variation in Rule 4. The model suggests that mothers first consider treatments that: a) slow the stool output, and b) they have more faith in. Implicitly the model suggests that mothers will try one treatment after another until the child returns to normal. Which treatment she considers first has a lot of bearing on what she does.

What Does Our Research Suggest for Intervention Projects in San José?

This study suggests tentative recommendations for intervention projects in San José. First, since treatments that involve possibly dangerous physical manipulations of the child's body relate to the belief in *empacho*, education programs should address this belief directly (Baer and Ackerman 1988; Kendall 1985; Kendall *et al.* 1984). Because community members do not uniformly hold this belief, targeting particular groups that hold the belief would probably be a more cost-effective manner for diminishing dangerous practices such as the use of purgatives.

Second, careful attention should be paid to the curative/palliative distinction. If the goal of an intervention project is to convince women to use a particular treatment at an early stage, the remedy should be billed as a cure. If it is already seen as a cure, then it should also be billed as a palliative. The latter strategy will likely increase use by those who first try their preferred treatment and then look for a remedy that makes the child feel better.

Third, increasing the availability of cheap medical care will probably not significantly increase the frequency of women seeking medical personnel. In the case of childhood diarrhea, medical care is sought when the illness is severe or has lasted for a week. Our informants failed to mention financial or transport constraints as a major rationale for not seeking medical personnel. Although we failed to measure financial or transport constraints directly (and in hindsight probably should have), our model correctly predicted whether or not a mother sought help from medical personnel in 90% of the cases. This was significantly greater than chance. If we included potential financial and transport constraints in the present model, at best these additional factors could account for only 10% of the unexplained variation.

Fourth, teaching women how to mix sugar-salt-solutions with locally available products may increase the use of sugar-salt-solution by removing the constraint. If, however, there is no accompanying change in women's preference for sugar-salt-solution or their perception of its function, there will be little change in use rates. Probably the most effective way to increase the use of sugar-salt-solution is to promote it as a powerful cure. Other investigators (Kendall *et al.* 1983:357) have also suggested this strategy for oral rehydration solution (ORS).

Fifth, in selecting which treatment is best on both fronts (curative and palliative), we would suggest rice water. In San José, its frequency of use is second only to tea. Although some people view rice water as a curative treatment, most consider it to be a palliative. Recent studies have shown rice water to mimic much of what ORS is intended to accomplish. It rehydrates children and replenishes lost electrolytes (Martínez *et al.* 1994; Molla *et al.* 1982). Rice water offers an added bonus of reducing stool frequency and output, and this allows health delivery specialists to market rice water as a curative remedy. This would increase its overall use and the probability of its being used earlier in a treatment episode.

Can we guarantee that our recommendations will work? Our recommendations are based on this study and are confirmed by other information and observations gathered as part of the larger valley-wide project. The difference between our study and other surveys conducted in the area is that we tested our model on an independent sample and the model did very well. Ideally, we should test the model on other samples throughout the valley. This would increase our sample size and constitute a powerful replication of an experiment. Checking the predictive power of a model, however, is just the first step (no matter how many times you do it). The next step is to try to use our theory to modify peoples' behavior. To do this, we need to design an intervention project based on the theory and see if it works. In a sense, an intervention project is the next logical step in confirming our understanding. It is a new Sample C, and is the most rigorous test of all.

What Have We Learned about How Laypeople Manage Illness Episodes?

Our research suggests that predicting lay behaviors depends on conditional rules, perceived constraints, ordering affects, and intracultural differences. None of these wholly determines behavior. In fact, there are a variety of conditional rules, perceived constraints, ordering effects and intracultural differences that do not appear to affect what people do. The trick is to identify and confirm which do affect behavior and which do not.

The conditional rules that played the most important role in determining mother's behavior in San José are linked to typologies of illness and signs of severity.

Although we cannot extrapolate the criteria that mothers in San José use to select among treatment alternatives to other cultures, we feel confident in suggesting that some beliefs and illness typologies (such as *empacho*) affect behavior a lot, while other typologies (such as stool color or specific theories of causation) do not. It remains to be seen whether some kinds of illness categories play a more important role in guiding behavior than others.

Improving the Decision-Modeling Techniques

In hindsight, we realize that our techniques for building and testing decision models can be improved. Decision models imply that some relationship of cognitive and noncognitive factors cause treatment behavior, not the other way around. Decision modeling requires that the modeler make two assumptions. First, at least some knowledge and beliefs affect behavior in a direct manner. Second, rules elicited from an informant are in fact part of the decision-making process and are not simply post-hoc justifications for behavior. That is, rules are not simply acts of cognitive dissonance reduction (Cohen and Moore 1988; Festinger 1957, 1964).

To assure that peoples' beliefs really affect their behavior and not the other way around, we should have collected data about peoples' beliefs before they actually confronted the illness (McKinlay 1972). This is probably unnecessary for collecting exploratory data in Sample A. Here we want people to recall a specific illness episode and explain their reasons for behaving in a particular fashion. For testing the model on Sample B, however, it would have been better if we had first surveyed all the mothers in the community about their beliefs regarding diarrhea and its treatment, and then included only those mothers who managed a diarrheal episode relatively soon afterward. That way we would be more sure that mothers held the beliefs in question before they acted and didn't simply form the beliefs to justify their behavior. Of course, the more peoples' beliefs tended to vary over time, the sooner we would have to collect our behavioral data after the surveys of beliefs.

Collecting accurate information about what people do remains a real problem for decision modelers of health behaviors because treatment actions tend to occur in short intervals, in different places, and at different times. For example, a mother might give her child a pill (in a matter of seconds), at night, in a neighbor's house. Since direct observation is extremely difficult to carry out, most modelers (ourselves included) rely on informants' recall of their past behavior. Consequently we are really modeling the behavior of how people recall treatment management. We assume that people's recall approximates their actual behavior to some degree.

We know, however, that recall data is extremely inaccurate and unreliable (Bernard *et al.* 1984; Deutscher 1973; Gesler 1979; Kroeger 1983; McKinlay 1972). Some researchers have argued that although recall data may be inaccurate for assessing whether or not a specific events occurred, recall does give researchers a general picture of what usually happens (Freeman *et al.* 1987; McNabb 1990). Obviously, the sooner we ask informants about a particular past behavior, the better data we expect to obtain. However, this still begs the questions: "How much error is there?" and "Is the error biased in any systematic direction?" For example, "Are there certain behaviors that informants are likely to forget or add when asked to recall past illness episodes?" If so, "How is this affected by time lags?" Although we may not be able to calculate an exact error rate between recall and behavior, examining the changes in recall over time would allow us to at least identify any systematic biases. These would help us estimate minimum or maximum error bounds in the data.

Ethnographic decision modeling has progressed from modeling simple yes/no behaviors (Gladwin 1980; Rytina 1982), to modeling multiple behaviors (Mathews and Hill 1990; Weller *et al.* 1996; Young 1981a). In our study, we go to the next level of trying to model treatment orders. Our model is still simplistic in that we only examine the rank ordering of treatment initialization. Future models may want to include time as another dimension. Although incorporating time into a model would add significantly to its complexity, it would allow us to better examine: a) how long people are willing to try treatments before stopping them; b) how long caretakers delay before beginning any treatment at all; and c) under what circumstances people use different treatments simultaneously.

We are also continuing to develop better accuracy measures for comparing observed (or reported) behavior with predicted behaviors. Examining the number of matches; measuring the difference between observed and chance outcomes; and calculating the probability of obtaining such levels of accuracy by chance alone are all steps in this process. The formulation and standardization of such measurements will continue to challenge decision modelers as we become more sophisticated in predicting multiple behaviors, in particular orders, over different time periods.

Improving ethnographic modeling techniques ignores the question of how well such techniques compare to other methods for modeling behavior. Weller *et al.* (1996) compare ethnographic decision modeling with other formal methods of analysis. They found that a multivariate model, based on a health service research approach (Becker and Maiman 1983), was better at predicting treatment practices in rural Guatemala than was an ethnographic decision model (23% versus 7% better than chance). In their study, however, Weller *et al.* found that both techniques identified similar variables which suggests that the two approaches complement one another. In Weller *et al.*'s analysis, the multivariate approach provided a broader view of how variables influenced health care and was better for understanding population utilization patterns. The decision-modeling approach, however, provided insights into how individuals made choices using available information. Research will determine when multivariate modeling or decision modeling is most appropriate. In the meantime, using multiple methods will provide more insight into phenomena of interest and will let us compare the advantages and disadvantages of different techniques. Improving our techniques for modeling and measuring medical choices, will challenge us to develop additional techniques for comparing models across illnesses, communities, and cultures.

NOTES

[1] We calculated "better than chance" as: (Observed Accuracy % - Chance Accuracy %)/(1-Chance Accuracy %). This formula is derived from the goodness-of-fit measure, *tau* (Klecka 1980). We wish to thank Susan Weller for her assistance in calculating this measure. We calculated "observed to expected ratio" as: (Observed Accuracy %)/(Chance Accuracy %). To calculate the "probability of obtaining observed levels of accuracy by chance alone," we did the following: suppose there are M occurrences of a treatment out of N cases, and K is the total number of omissions and commissions that the model makes while estimating these occurrences. The probability of obtaining an accuracy measure as good as chance alone is: a) the total number of combinations in which at least the observed accuracy score (N-K) that can be obtained; divided by b) the total number of combinations obtained at random. Let ${}_aC_b$ stands for the number of combinations of b from a. The basis theorem says that ${}_aC_b$ = a!/b!(a-b)!. We calculate the numerator by adding up all combinations that give accuracy scores greater than or equal to N-K. There is only one combination the gives a perfect score N (K=0). In order to get a lower score, we have to swap an occurrence of a treatment with the nonoccurrence of a treatment. This results in scores always having the same parity as N. The number of ways to score N-2 = ${}_MC_1 \bullet {}_{N\text{-}M}C_1$, and the number of ways to score N-4 = ${}_MC_2 \bullet {}_{N\text{-}M}C_2$, etc. In general, the ways to score N-2K = ${}_MC_K \bullet {}_{N\text{-}M}C_K$. After we sum the combinations that produce scores greater or equal to those observed in our model, we divide by the total number of random combinations (${}_MC_N$). This gives us the probability of obtaining an accuracy measure as good as chance alone. We would like to thank Peter Killworth for his assistance in calculating this measure.

REFERENCES CITED

Allen, Lindsay H., Gretel H. Pelto, and Adolfo Chávez
1987 The collaborative research and support program on food intake and human function: Mexico project. Submitted to the Agency for International Development, Grant # DAN-1309-G-SS-1070-00.

Baer, Roberta and A. Ackerman
1988 Mineral folk remedies in Latin America: the use of arsenic, lead and bismuth. Mimeograph.

Becker, Marshall H. and L.A. Maiman
1983 Models of health related behavior. *In* Handbook of health, health care, and the health professions. David Mechanic, ed. Pp. 539-568. New York: The Free Press.

Bentley, Margaret E.
1988 The household management of childhood diarrhea in rural North India. Social Science and Medicine 27:75-85.

Bentley, Margaret E., Gretel H. Pelto, Lindsay H. Allen, Meenu Mathur, and Dijouratie Sanogo
1992 Child feeding during diarrhea in North India: the use of complementary methods. *In* Anthropological research: process and application. J. J. Poggie Jr., B. R. DeWalt and W. W. Dressler, eds. Pp. 69-95. Albany: State University of New York Press.

Bernard, H. Russell, Peter Killworth, David Kronenfield, and Lee Sailer
1984 The problem of informant accuracy: the validity of retrospective data. Annual Reviews in Anthropology 13:495-517.

Black, Robert E., Kenneth H. Brown, and Stan Becker
1984 Effects of diarrhea associated with specific enteropathogens on the growth of children in rural Bangladesh. Pediatrics 73:799-805.

Borgatti, Stephen
1990 ANTHROPAC 3.02. Colombia, SC: Analytic Technologies.

Cohen, Joel and Danny L. Moore
1988 Postdecision consistency enhancing processes. Unpublished working paper. Center for Consumer Research, University of Florida, Gainesville, Florida.

Coreil, Jeannine and Eddy Genece
1988 Adoption of oral rehydration therapy among Haitian mothers. Social Science and Medicine 27:87-96.

DeClerque, Julia, Patricia Bailey, Barbara Janowitz, Rosalie Dominik, and Carlos Fiallos
1992 Management and treatment of diarrhea in Honduran children: factors associated with mothers' health care behaviors. Social Science and Medicine 34:687-695.

Deutscher, Irwin
1973 What we say/what we do: sentiments and acts. Glenview, IL: Scott, Foresman and Company.

Escobar, G. J., E. Salazar, and M. Chuy
1983 Beliefs regarding the etiology and treatment of infantile diarrhea in Lima, Peru. Social Science and Medicine 17:1257-1269.

Fabrega, Horacio, Jr.
1974 Disease and social behavior: an interdisciplinary perspective. Cambridge, MA: M.I.T. Press.

Festinger, Leon
1957 A theory of cognitive dissonance. Evanston, IL: Row and Peterson.
1964 Conflict, decision and dissonance. Stanford: Stanford University Press.

Freeman, Linton, A. Kimball Romney, and Sue Freeman
1987 Cognitive structure and informant accuracy. American Anthropologist 89:310-325.

Gesler, Wilbert M.
1979 Morbidity measurement in household surveys in developing areas. Social Science and Medicine 13D:223-226.

Gladwin, Christina
1980 A theory of real-life choice: applications to agricultural decisions. *In* Agricultural Decision Making: Anthropological Contributions to Rural Development. Peggy F. Barlett, ed. Pp. 45-85. New York: Academic Press.
1989 Ethnographic decision tree modeling. Newbury Park, CA: Sage Publications.

Green, Edward C.
1985 Traditional healers, mothers and childhood diarrheal disease in Swaziland: the interface of anthropology and health education. Social Science and Medicine 20:277-285.

Kendall, Carl
1985 The mass media and health practices evaluation in Honduras: a report of the process evaluation. Menlo Park, CA: Applied Communication Technology.

Kendall, Carl, Dennis Foote, and Reynaldo Martorell
1983 Anthropology, communications, and health: the mass media and health practices program in Honduras. Human Organization 42(4):353-360.
1984 Ethnomedicine and oral rehydration therapy: a case study of ethnomedical investigation and program planning. Social Science and Medicine 19:253-260.

Klecka, William R.
1980 Discriminant Analysis. Sage Quantitative Applications in the Social Sciences, Vol. 19. Beverly Hills: Sage Publications.
Kleinman, Arthur
1980 Patients and healers in the context of culture: an exploration of the borderland between anthropology, medicine, and psychiatry. Berkeley: University of California Press.
Kroeger, Axel
1983 Health interview surveys in developing countries: a review of methods and results. International Journal of Epidemiology 12(4):465-481.
Kumar, V., C. Clements, K. Marwah, and P. Diwedi
1981 Maternal beliefs regarding diet during acute diarrhea. Indian Journal of Pediatrics 48:599-603.
Martínez, Homero
1988 A clinical and field study of the safety, acceptability and effectiveness of home-made beverages and early feeding for the management of acute childhood diarrhea. *In* Report to Applied Diarrheal Disease Research Project. Harvard Institute for International Development.
1990 Alimentos de uso común en la communidad para el tratamiento de las diarreas. *In* Prevención y control de las diarreas. F. Mota, ed. Mexico: SSA/OPS/UNICEF.
Martínez, Homero, Juan Calva, Luz María Menesses, and Higinia Viais
1991 Uso de bebidas y alimentos en el hogar en el manejo de la diarrea aguda del niño: estudio etnográfico en una zona rural Mexicana. Boletín Medical del Hospital Infantil de México 48:235-242.
Martínez, Homero, Jean-Pierre Habicht, Cutberto Garza, and Felipe Mota
1994 Rice-powder oral rehydration beverage as prepared at home proves effective in a clinical trial. Food and Nutrition Bulletin (under review).
Martorell, R., C. Yarbrough, A. Lechtig, J. P. Habicht, and R. Klein
1975 Diarrheal diseases and growth retardation in preschool Guatemalan children. American Journal of Physical Anthropology 43:341-346.
Mata, L. J., J. J. Urrutia, C. Albertazaai, O. Pellecer, and O. Arellano
1972 Influence of recurrent infections on nutrition and growth of children in Guatemala. American Journal of Clinical Nutrition 25:1267-1275.
Mathews, Holly F. and Carole Hill
1990 Applying cognitive decision theory to the study of regional patterns of illness treatment choice. American Anthropologist 91:155-170.
McKinlay, John B.
1972 Some approaches and problems in the study of the use of services — an overview. Journal of Health and Social Behavior 13(2):115-152.
McNabb, Steven L.
1990 The uses of "inaccurate" data: a methodological critique and applications of Alaska native data. American Anthropologist 92:116-129.
Molla, A., S. Sarker, M. Hossain, and W. Greenough III
1982 Rice-power electrolyte solution as oral therapy in diarrhoea due to *Vibrio cholerae* and *Escherichia coli*. The Lancet 2:1317-1319.
Nations, Marilyn K.
1982 Illness of the child: the cultural context of childhood diarrhoea in Northeast Brazil. Unpublished Ph.D. dissertation, University of California, Berkeley.
Nichter, Mark
1988 From *aralu* to ORS: Sinhalese perceptions of digestion, diarrhea, and dehydration. Social Science and Medicine 27:39-52.
Oths, Kathryn S.
1994 Health care decisions of households in economic crisis: an example from the Peruvian highlands. Human Organization 53(3):245-254.
Pelto, Pertti J. and Gretel H. Pelto
1990 Field methods in medical anthropology. *In* Medical Anthropology: Contemporary Theory and Method. T. M. Johnson and C. F. Sargent, eds. Westport, CT: Greenwood Press.
Romney, A. Kimball, Susan C. Weller, and William Batchelder
1986 Culture as consensus: a theory of culture and informant accuracy. American Anthropologist 88:313-339.
Rytina, Steve
1982 Structural constraints on intergroup contact. *In* Social Structure and Network Analysis. P. Marsden and N. Lin, eds. Pp. 81-100. Beverly Hills: Sage Publications.
Scrimshaw, Susan C. M. and Elena Hurtado
1988 Anthropological involvement in the Central American diarrheal disease control project. Social Science and Medicine 27:97-105.
Smith, George Davey, Anna Gorter, Joost Hoppenbrouwer, Annemarie Sweep, Rosa María Pérez, Carmen González, Patricia Morales, Josefina Pauw, and Peter Sandiford
1993 The cultural construction of childhood diarrhoea in rural Nicaragua: relevance for epidemiology and health promotion. Social Science and Medicine 36:1613-1624.
Stapleton, Maire Casey
1989 Diarrhoeal diseases: perceptions and practices in Nepal. Social Science and Medicine 28:593-604.
Trotter, Robert T., II, Bernard R. Ortiz de Montellano, and Michael H. Logan
1989 Fallen fontanel in the American Southwest: its origin, epidemiology and possible organic causes. Medical Anthropology 10:207-217.
UNICEF
1993 State of the world's children. New York: UNICEF.
Vega, Franco, L, T. Toca, C. E. Rojas, *et al.*
1979 Las enfermedades de los niños en la medicina tradicional. Boletín Medical del Hospital Infantil de México [supl. 2]:69-87.
Weiss, Mitchell G.
1988 Cultural models of diarrheal illness: conceptual framework and review. Social Science and Medicine 27:5-16.
Weller, Susan C., Trenton K. Ruebush II, and Robert E. Klein
1991 An epidemiological description of a folk illness: a study of *empacho* in Guatemala. Medical Anthropology 13:19-31.
1996 Predicting treatment-seeking behavior in Guatemala: a comparison of the health services research and decision-theoretic approaches. Medical Anthropology Quarterly.
Woods, Clyde M. and Theodore D. Graves
1976 The process of medical change in a highland Guatemalan town. *In* Medical Anthropology. F. X. Grollig and H. B. Haley, eds. Pp. 331-382. The Hague: Mouton Publishers.
Young, James C.
1980 A model of illness treatment decisions in a Tarascan town. American Ethnologist 7:106-151.
1981a Medical choice in a Mexican village. New Brunswick, NJ: Rutgers University Press.
1981b Non-use of physicians: methodological approaches, policy implications, and the utility of decision models. Social Science and Medicine 15B:499-507.
de Zoysa, Isabelle, Debbie Carson, Richard Feachem, Betty Kirkwood, Euan Lindsay-Smith, and Rene Loewenson
1984 Perceptions of childhood diarrhoea and its treatment in rural Zimbabwe. Social Science and Medicine 19:727-734.