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A Systems-Based Evaluation Planning Model for Health Communication Campaigns in Developing Countries

Ronald E. Rice and Dennis Foote

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Systematic evaluation of health and nutrition communication campaigns in less developed countries is of paramount importance because poor health conditions continue to stifle human and national potential, high levels of governmental and individual resources are involved, and the cumulative knowledge about how to design communication interventions effectively in such settings is inconsistent. Salmon and Kroger (1992) argue that most campaigns either explicitly or implicitly focus on 1) the individual level rather than system level, and 2) effects rather than processes and structures of campaigns (see also Dorfman & Wallack, Chapter 23; Salmon & Murray-Johnson, Chapter 7). Thus, this chapter presents a systems-theoretic framework for planning evaluations of health communication campaigns in less-developed countries, to identify relevant variables and processes, and to facilitate more effective and focused efforts.

Systems theory argues that there are common structures and processes operating in phenomena regardless of the research discipline applied (Berrien, 1968; Bertalanffy, 1968; Buckley, 1968). These structures include a system (a set of interacting and interdependent elements, components, or subsystems functioning within a common boundary), some

common goal(s), and a surrounding environment (a set of inputs and constraints). A system such as a rural community exists in an *initial state* in an environment (such as the state of high infant morbidity and mortality in a developing country), obtains or receives *inputs* such as a health campaign, processes them according to *goals and constraints* (such as improved health, insufficient water, or cultural norms concerning illness and maternal care), develops *outputs* (such as lower infant mortality or a reorganized health care delivery system), and receives *feedback* from the environmental actors and elements (such as increased support, political opposition, changed social norms, competition from other systems, need for maintenance, etc.). One of the six theoretical approaches to corporate and social issues campaigns explicated by Bridges (2004) is *systems theory*, a common foundation for public relations and issues management processes. This approach emphasizes the interdependency of an organization in larger economic, political, and social systems, the tendency toward homeostasis, and adaptation based on feedback from the environment relative to a goal state.

Health communication campaigns, for example, are appropriately conceived of as systems of influence, both with respect to the multiple media, message, audience, community, and environmental systems and with respect to the campaign organizations and actors as production and political systems (McLeroy, Bibeau, Steckler, & Glanz, 1988; Ray & Donohew, 1990; Salmon & Kroger, 1992; Winett, 1986). Campbell, Steenbarger, Smith, and Stucky (1982) applied this systems perspective in evaluating a community counseling project, concluding that taking a systems perspective leads to a widening of the scope of the original evaluation questions, increasing the range of evaluation tools necessary to understand the system. Rudd, Goldberg, and Dietz (1999) also proposed and analyzed a comprehensive systems-based approach for sustaining community campaigns. Salmon and Kroger (1992) analyzed the National AIDS Information and Education Program as both an organizational system and a (campaign) system of influence. The Centers for Disease Control and Prevention (2009) provides very detailed guidelines and resources (what they call Procedural Guidance) for a range of community-based campaigns and interventions related to HIV/AIDS. Both social marketing and community campaigns implicitly presume an interdependent system of actors, subsystems, environments, resources, and values (see also Bracht & Rice, Chapter 20).

The proposed evaluation planning model derived from Suchman (1967) involves the following (often interrelated, iterative, and interactive) stages: 1) specifying the goals, assumptions, and related projects, 2) specifying the system and the process model, 3) specifying prior states and system phases, 4) specifying system constraints and intervention inputs, 5) specifying immediate and long-term goals, 6) specifying the process model at the individual level, 7) choosing among research approaches appropriate to the system, and 8) assessing implications for design.

SPECIFYING THE GOALS, ASSUMPTIONS, AND RELATED PROJECTS

One of the major causes of infant mortality in developing countries is diarrheal disease. It occurs at significant levels in practically every country, made worse by poor nutrition and bad sanitary conditions. Averaged over studies published between 1992 and 2000, 4.9 children

under five years old per 1,000 per year died for a median of 21 % of all deaths in this age range (while nearly 20 out of 1,000 die of diarrhea-related dehydration before their second birthdays), and an estimated total of 2.5 million per year (Kosek, Bern, & Guerrant, 2003). Death is typically caused by dehydration—loss of fluids and electrolytes—before the child’s natural defenses can defeat the cause of diarrhea. Less acute consequences—malnutrition and waste of human and material resources—are even more common.

Since the 1960s, a diverse set of approaches to reducing diarrhea-related infant mortality has been studied, including immunization, improved water availability, disposal of excreta, weaning education, reduction of infection through animals and insects, and oral rehydration therapy (ORT) (Feachem, 1986; Hornik, 1985, 1993). ORT is a comprehensive approach that includes breast-feeding, improved nutrition, and sanitary practices. In addition, an inexpensive oral rehydration solution (ORS) that treats the dehydration by replacing fluids and electrolytes has been developed. ORT-oriented campaigns have significantly decreased diarrhea-related infant deaths around the world. For example, an ORS program in Egypt reduced deaths attributed to diarrhea 82 % for infants and 62 % among children, although the program took nearly five years to raise sufficient awareness after lessons learned from the testing of a nurse–mother community pilot program in 29 rural villages (Levine, 2007). There are, however, considerable problems associated with ORS, such as dangers from improperly mixed solutions, worsening of diarrhea symptoms, and difficulties in distributing ingredients (Hornik, 1985). Huttly, Morris, and Pisani (1997) provide a comprehensive review of causes of and interventions for morbidity and mortality effects of infant diarrhea in developing countries.

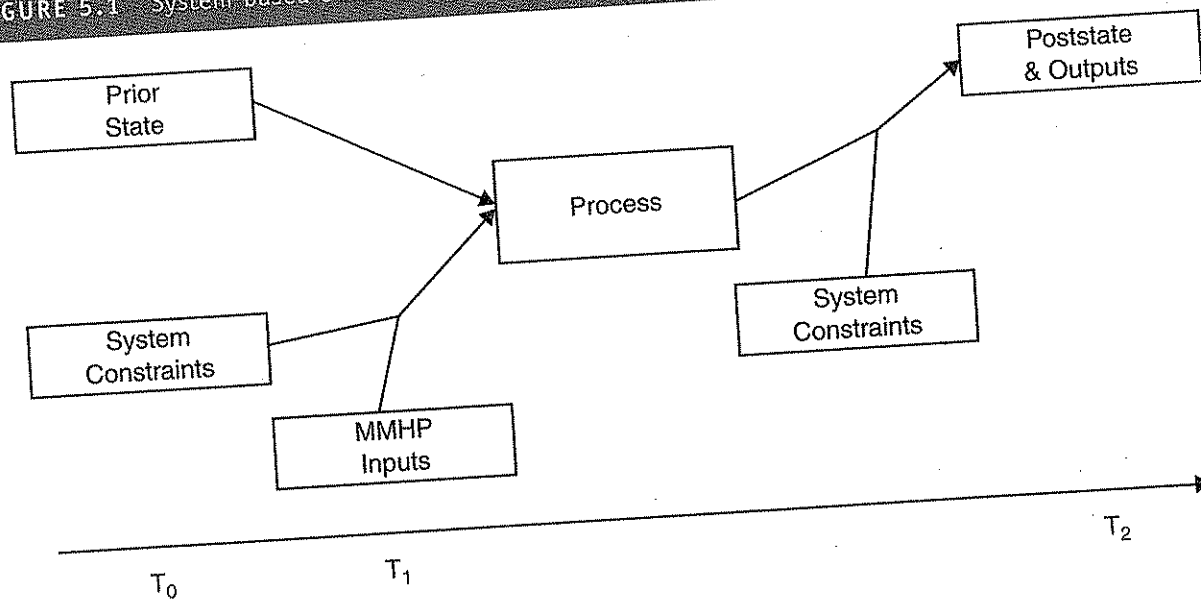
One of the classic campaigns to improve prevention and treatment of diarrheal infant mortality was a joint effort of USAID and the Ministries of Public Health of Honduras and The Gambia to carry out the large-scale Mass Media and Health Practices (MMHP) project. A subsequent USAID-supported project, HEALTHCOM (Hornik, 1993), expanded the approach to more than 20 countries and helped to carry on the effort in Honduras where ORS (comprising sodium, glucose, potassium, and bicarbonate, called Litrosol) was distributed in packets to be mixed with one liter of water. In The Gambia, ORS was mixed at home, with eight bottle caps of sugar, one cap of salt, and three bottles (one liter) of water, partially due to the expense of ORS packets (over a dime, not including internal distribution costs) and partially to avoid production dependencies.

SPECIFYING THE SYSTEM AND THE PROCESS MODEL

Figure 5.1 presents an overview of the systems-based evaluation planning model. Taking a systems perspective, this model shows that, before any intervention, there exists a prior state (of the people, their family, their community, the environment, the economy, mortality and morbidity rates, sanitary conditions, nutritional levels, etc.) that is the baseline to which ongoing and final evaluation measurements are compared and constraints existing in the system that affect how the population interacts with the intervention.

The prior state, system constraints, and the intersection of system constraints and intervention inputs interrelate and feed into the process component. For example, perhaps

FIGURE 5.1 System-based evaluation planning model.



a family learns new approaches to sanitation and wants to perform them but cannot because personal, cultural, or economic conditions prevent them from buying soap, using sufficiently clean water, or believing in bacteria. Thus, system constraints can block or transform the progression from process to output.

The subsequent condition of the goal population constitutes a new or poststate. This poststate, which includes outputs from the process components, consists of the information, attitudes, behaviors, and health status of individuals, as well as many of the conditions measured in the prior state component. Many of the values of the variables measured may not have changed; some would not be expected to change. And, some new aspects of the system may have been introduced, such as new health communication infrastructures or, in the long run, a rise in population growth, leading to a new set of constraints and conditions. Of course, because such interventions occur over a lengthy period of time, this whole model may repeat itself in various phases.

Perhaps the most important analytical aspect of an evaluation of a complex campaign is the need to consider, measure, and assess the effect of the major variables that help explain why certain outputs occurred as well as why certain others did not. Such explanations are typically couched in terms of *program* or *theory* failure (see Valente & Kwan, Chapter 6). Broadly, program failure results when the program is not or cannot be implemented as planned due to factors such as the use of inappropriate messages or language or dependency on an insufficient distribution system. Theory failure, assuming successful

program implementation, occurs when one or more of the hypothesized causal links are not supported by the evaluation data (e.g., when people who know what the appropriate behavior is understand why it might be to their advantage to adopt it and have access to the necessary resources yet nevertheless fail to adopt) or have unexpected effects (e.g., when greater participation in a campaign-related event is associated with decreased learning).

The likelihood of program and theory failure increases as we move along the process components from more immediate outcomes, such as knowledge levels, to longer-term outcomes, such as health status or mortality rates, for three basic reasons. First, we generally hypothesize that the components are causally related and thus those subjects who do not choose to, fail to, or are unable to complete one component become unavailable for the remaining components. Second, the cumulative effect of constraints and intervening variables, over which the implementer has no control, is almost certain to decrease the probability of occurrence of the postulated causal processes. Third, even if each component is accomplished, the relative strength of change is stochastic so that the final outcome from many successful components may still be hard to detect (see McGuire, Chapter 9).

SPECIFYING PRIOR STATES AND SYSTEM PHASES

Specifying the Prior State

The prior state of the environment can be conceptualized as clusters of variables identified by theoretical processes and prior empirical results, including community or population; household; communication; sanitation; information, attitudes, and behaviors; nutrition; general health; and child-care practices.

Specifying System Phases

Fundamental to understanding the evaluation process is the fact that the system, and thus the implementation of the treatments, exists and changes over time. Description and analysis of the prior state and system constraints will lead to specification of variables by system phase, identifying when certain interventions should be applied and for which goal populations.

The MMHP campaigns organized their messages in phases according to temporal fluctuations (the rainy and dry seasons affect the type and amount of diarrhea) and a model of cumulative impact. Activities were phased to train health workers at the beginning and to follow a sequence of information, enabling behaviors, and reinforcement in messages for the general population. During the rainy season of Phase II, diarrhea rates were high, so the central messages, conveyed by intensive media intervention, focused on the purpose, availability, proper mixing, and regimen for ORT. In Phase III, after the rainy season had passed, the intervention messages promoted selected prevention behaviors as well as maintaining the treatment behaviors. Phase IV was during the next rainy season, so the

intervention returned to its treatment focus with selected prevention messages. In Phase V, after the rainy season had passed, the role of breast-feeding in ORT and its more general benefits were emphasized.

SPECIFYING SYSTEM CONSTRAINTS AND INTERVENTION INPUTS

Specifying System Constraints

It is necessary to detect and measure system constraints that may block or transform the progression from inputs to outputs, such as resources, cultural beliefs (e.g., diarrhea is often seen as a normal way to purge harmful illnesses such as measles; Green, 1986), medical community, environment, and delivery of interventions. The pervasiveness of system constraints, even as manifested in how interventions are designed, may well prevent any substantive improvement in the population's health status (e.g., a program failure). For example, Cornish and Campbell (2009) noted that results of peer education are inconsistent and highly dependent on the context. They compared two programs in India and South Africa, intended to empower sex workers to require condom use, identifying success factors such as including stable and supportive networks and political and infrastructural resources, engagement of local stakeholders, and community development orientation instead of only a biomedical one.

Once the linkages between intervention inputs and potential outputs are specified theoretically, it becomes crucial to identify distinctions among planned inputs (e.g., media, medical practices, ORS packets), delivery constraints, real inputs, resource and access constraints, engaged inputs, and final engagement by individuals—that is, what is perceived by the intended audience as being input. These engaged inputs must be considered the basis for potential measures of exposure, attention, and recall in analyzing change and poststate measurements and, as such, still do not represent the final basis upon which to assess theory failure or success. Thus tests of program success should use data on planned and real inputs; tests of theory success should use data on real and engaged inputs.

Media Inputs

In The Gambia at the time of the study, 60% of household compounds had at least one working radio receiver; in those compounds, 75% of the women listened to Radio Gambia, which delivers the MMHP spots, so only 45% of the women in the general population could potentially directly engage in processing the campaign's radio messages. Compare this engaged radio input to the 3% literacy rate by individual women, which would prevent any substantial engagement with print messages. Thus one strategy in The Gambia project was to provide color-coded flyers or wall posters with mixing instructions, which were explained and reinforced through radio messages. In Honduras, 67% had a working radio. Averaged over several waves, from 9:00 a.m. to 10:00 a.m., 19% listened to their radios, and 60% of those reported hearing the campaign spot, representing 12% of the population. From noon to 1:00 p.m., the figures were 35%, 81%, and 28%, respectively.

Each planned media input, such as radio spots, can be coded for goal audience and frequency, region, and station. Specific messages can be coded by implementation phase within each specific input. That is, only a few messages in certain media are project inputs in each phase for each subaudience. Therefore, the relative efficacy or recall of those messages, by medium, can be compared to the relative efficacy or recall of different messages, by medium, in later phases.

For example, in The Gambia project, the color-coded instruction flyers were the most significant print media input. The presence of mixing flyers that mothers put up in their homes significantly influenced earlier learning about and use of ORT and later-occurring forgetting or disadoption of ORT, whereas the recalling of radio messages led to earlier forgetting and disadoption (Snyder, 1991). One explanation is that putting the flyer up was associated with taking action concerning ORT, while remembering hearing the message was not necessarily associated with immediate action. When hearing was contemporaneous with learning about ORT or adopting it, then respondents learned earlier and maintained use longer (Snyder, 1991).

Resource Inputs

The distribution of ORS packets with associated print material is considered a planned resource input, which also must be monitored to determine engaged inputs to goal populations. Differential distribution by channel (commercial or public health outlets) or by geographical region (closer or farther from roads) may help explain why intervention efforts are differentially successful in various regions.

Audience Inputs

Relevant populations other than the goal caretaker or child populations—direct contact personnel, such as health workers and physicians, and indirect contacts, such as volunteer care workers—can be viewed as additional inputs or constraints. Goal audiences can be asked about these interpersonal diffusion channels that may help to spread or resist mass media inputs (Coleman, Katz, & Menzel, 1966; Rogers & Kincaid, 1981). For example, local health workers have been shown to be a significant influence in campaigns to teach correct ORS mixing or to support proper weaning as approaches to reducing diarrhea-related infant deaths (Feachem, 1986; Kumar, Monga, & Jain, 1981). For example, in The Gambia, village health volunteers trained by the health workers were identified by red flags outside their compounds. Local mothers could come to these red flag volunteers to learn how to mix the ORS correctly. However, the volunteers were not supported throughout the campaign by health workers, so this indirect interpersonal channel disappeared.

SPECIFYING IMMEDIATE AND LONG-TERM GOALS

In the Honduran and Gambian projects, categories of *cognitive* outcomes included attention to—and recognition, recall, and knowledge of—nutritional and preventive behaviors and

ORT messages. Categories of *behavior* outcomes included response to diarrheal episodes (e.g., administration of ORT, taking child to clinics), infant feeding practices, water quality, prevention, and personal hygiene. Categories of *health* outcomes included nutritional status, morbidity (frequency, severity, and duration of diarrhea), and mortality. Categories of *system* outcomes included the institutionalization of ORT in the health system, improvements in communication about infant health and ORT, distribution of ORT in clinics and through community outlets, and incorporation of ORT in national and local training (for detailed results, see this chapter in the second edition of *Public Communication Campaigns* and McDivitt, Hornik, & Dara, 1994).

SPECIFYING THE PROCESS MODEL AT THE INDIVIDUAL LEVEL

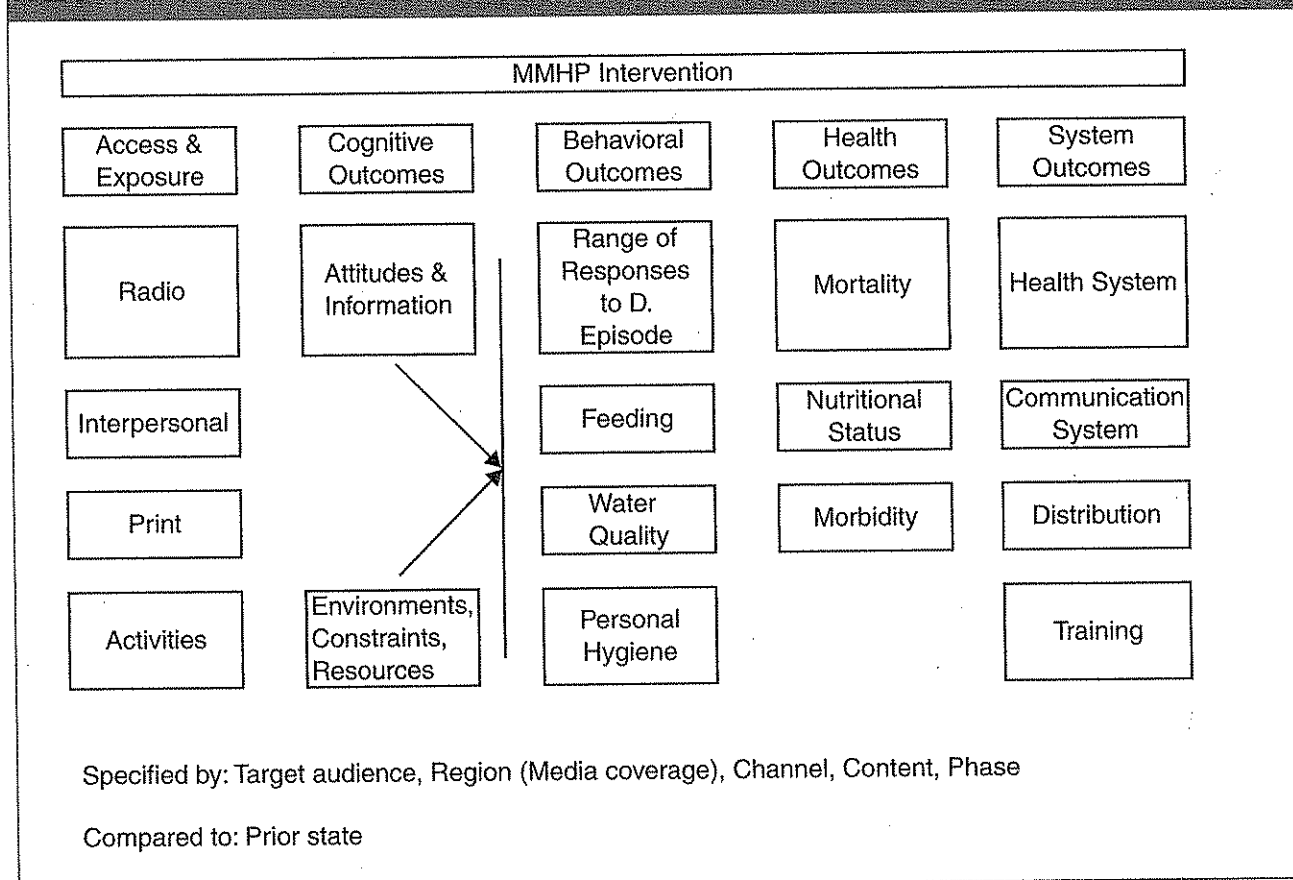
The individual-level process model used in the MMHP projects was derived from three theoretical foundations of health communication campaigns. The HBM considers whether individuals believe they are susceptible, whether the messages are relevant, and whether the individuals have options. Concepts such as self-efficacy, internal information processing, and attitudes are important components of this model (Hornik, 2002). The *social marketing* framework emphasizes the identification of markets and audiences and how to place and price a product (Bracht & Rice, Chapter 20). The *communication/persuasion matrix* (McGuire, Chapter 9) shows communication variables as inputs (source, message, channel, receiver, and destination factors) and the "successive response steps that must be elicited in the public if the communication campaign is to be effective" as outputs. Evaluation efforts should gather information on some factors affecting these prior stages, such as cultural constraints or against yielding to a particular argument about, say, the amount of liquids a baby can ingest, or against comprehension of the distinction between bottle- and breast-feeding.

The MMHP evaluation attempted to monitor or measure some of these individual processes (see Figure 5.2). Each of these steps is accompanied by measurement or monitoring of intervening variables and system constraints that prevent full linkage to the next step and of unforeseen outputs of a prior step. The application of this evaluation approach allows insights into the diagnosis of problems within a given project (program failures) and to design principles for this type of project (here subsumed as theory failures). For example, when emphasis and reinforcement of specific messages are not sustained, initial gains can quickly be lost. It was clear that mothers were not following a simple pattern of adoption followed by sustained use. Snyder (1991), analyzing seven aggregated waves of The Gambia data, showed that use of ORT was maintained by 70% of the initial adopters after five months, 50% after 13 months, and only 30% after 21 months. Although only 8% started using ORT and then stopped permanently, 57% started, stopped, and started again.

CHOOSING AMONG RESEARCH APPROACHES

The MMHP evaluation used six major study groupings that differed markedly from one another in magnitude, study population, and measurement requirements: 1) a *longitudinal*

FIGURE 5.2 Evaluation of individual processes, intervening processes, and system constraints.



study including monthly measures and observations and analyses to detect sequencing and linkage among process components, 2) a *mortality* study, in Honduras, an interrupted time-series analysis to detect change in mortality due to infant diarrhea in treatment area, 3) an *opinion leader and health professional* interview study to elicit assessment of project impact and organizational success, 4) an *ethnographic* study to provide more anthropological insights into impacts, customs, and beliefs, 5) an *archival* study to assess clinical and hospital measures of infant mortality, morbidity, treatment, and so on, and 6) a *cost-effectiveness* study to aid in understanding relative payoffs for future programs. For example, the cost-effectiveness of the Egyptian ORS study was estimated between \$100 and \$200 per death averted (Levine, 2007). An earlier analysis estimated that, for diarrheal diseases in children under five years old, costs were between \$30 and \$100 for each disability-adjusted life year saved or \$3000 per death prevented (Murray, Kreuser, & Whang, 1994). Particular project contexts may lead to emphasis or rejection of one or more of these study approaches as well as the need for triangulation by means of multiple methodologies and data sources to compensate for barriers to one or more planned studies (Kreps, 2008).

IMPLICATIONS FOR DESIGN

Sampling

Issues of sampling and control groups are crucial to any campaign evaluation (see Valente & Kwan, Chapter 6). Insights from analysis of the prior state and system constraints, given a set of project goals, will help establish proper sampling frames and units of analysis.

For example, because health delivery infrastructure and broadcast media are typically in place before project intervention, these often establish treatment, and thus sampling, boundaries. Because the objectives of the MMHP evaluation included developing a transnational model of health communication evaluation, the primary objective of sampling was to enable generalizations to the full range of conditions (e.g., prior states, inputs, and constraints) represented in developing countries rather than to make possible precise statements about aggregate national levels in a given country.

Particular system contexts and constraints will influence the analytical level. For example, noninstitutional infant care is delivered in the home; therefore, all individual variables must be linked to a home unit. But, what is a *home*? In Honduras, a household was defined as a living unit that contains both a place for cooking and a place for sleeping. Thus, in Honduras, 750 mothers were randomly selected from 20 stratified villages. In The Gambia, however, the home is a compound of 10 to 100 people, consisting of physical structures enclosing polygamous multifamily living units. Thus infant care can never be attributed solely to the attitudes and cognitive and behavioral levels of one individual. Thus, in The Gambia, 1,029 mothers were sampled from compounds selected randomly from 20 stratified villages.

Control Groups

Because resources for fieldwork are limited, it is crucial to think through carefully the value of mounting data collection efforts in nontreatment areas (Suchman, 1967). The Gambia project, which was nationwide from the beginning, was able to have 20 treatment villages receiving multiple measurements and eight villages measured only once (to test for measurement effects), but there were no nontreatment controls. In the Honduras project, because the government rapidly expanded from the pilot site to a national campaign to promote the use of ORT, it became impossible to identify a group outside of the treatment area that had not received some kind of treatment, however minor. Furthermore, because the project effort was not uniform within the pilot region, it was not possible to assign households randomly to treatment conditions. Thus, neither project involved nontreatment groups, but both projects incorporated nonrepeated measures groups to test for measurement influences.

Comparisons Within the Treatment Area

Five sources of data within the treatment area from the study groupings could be used for within-treatment control purposes, as in the Honduras project.

1. *Household as its own control.* Local interviewers can return for repeated measurements to households that could then serve as their own controls for many variables.
2. *Making use of staged implementation.* If, because of phases in system constraints, components of the campaign are introduced in different phases in different regions of the treatment area, the study can compare as yet untreated segments of the population within the measurement sample to treated segments.
3. *Natural variations in exposure.* Because of the vagaries that can be expected in mounting a complex intervention, there will be program failure in some components of the campaign. These variations, if inputs are adequately monitored, can be used for comparison purposes.
4. *Self-determination of exposure.* Some people will select not to expose themselves to a health campaign because they do not have access to a radio, because they do not choose to talk to health workers, and so on. Although not necessarily comparable, they can be a source of some kinds of information with which to compare exposed respondents.
5. *Measurement effects.* A smaller sample in both Honduras and The Gambia was interviewed only once or twice across the longitudinal survey to compare to the larger sample, which may have been sensitized by the multiple interviews.

Comparisons With Nontreated Populations

Data about people outside the treatment area can be obtained from several sources, such as archival data, ethnographic studies, other health projects functioning in the region, and standardized data on infant growth and weight. Special one-shot studies may assess the level of a belief or practice in a nontreatment area when results in the treatment area are ambiguous.

The Question of Controls in a Longitudinal Study

Sources of control data for variables falling in each of the outcome categories may vary in accessibility and utility. For example, beliefs, practices, and levels of knowledge can change quickly on exposure to campaign intervention, so repeated measures can capture changes in these outcomes between implementation stages but probably not levels of health status variables, such as changes in mortality due to dehydration.

In the Honduran and Gambian projects, the focus was on infant feeding and child-care practices in traditional communities, areas where rapid changes are not expected to occur in the absence of external stimuli. Thus, it seemed that monitoring other information inputs (via the ethnographic and interview studies) into the treatment villages would be a more efficient way to evaluate rival explanations for change than collecting measures on control populations whose comparability is open to some doubt. If mothers began preparing ORS in the household, this change in behavior could be attributed only to the health education campaign because it represents the adoption of a new behavior.

Conclusion

This chapter has argued that evaluation of purposive communication projects in less-developed countries has much to gain from the use of a generic planning model based upon a systems approach. Using the example of ORT projects in two developing countries, the model highlights the need to identify and measure eight evaluation components from a systems perspective. The use of such a planning model could not only help guide the development and application of evaluation efforts, and provide a common framework for use in related projects, but more importantly, lead to more effective campaign interventions.

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