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# Understanding the relationship of maternal health behavior change and intervention strategies in a Nicaraguan NGO network

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**Abstract**

Few studies of community interventions examine independent effects of investments in: (1) capital (i.e., physical, human and social capital), and (2) management systems (e.g., monitoring and evaluation systems (M&E)) on maternal and child health behavior change. This paper does this in the context of an inter-organizational network. In Nicaragua, international non-governmental organizations (NGOs) and local NGOs formed the NicaSalud Federation. Using Lot Quality Assurance Sampling (LQAS), 14 member organizations took baselines measures of maternal safe motherhood and child health behavior indicators during November 1999 and August 2000, respectively, and final evaluation measures in December 2001. In April 2002, retrospective interviews were conducted with supervisors and managers in the 14 organizations to explore changes made to community health strategies, factors associated with the changes, and impacts they attributed to participating in NicaSalud. Physical capital (density of health huts), human capital (density and variety of paramedical personnel) and social capital (density of health committees) were associated with pregnant women attending antenatal care (ANC) 3+ times, and/or retaining ANC cards. The variety of paramedic personnel was also associated with women making post-partum visits to clinics. Physical capital (density of health huts) and social capital (density of health committees and mothers' clubs) were associated with child diarrhea case management indicators. One safe motherhood indicator (delivery of babies by a clinician) was not associated with intervention strategies. At the management level, NicaSalud's training of members to use LQAS for M&E was associated with the number of strategic and tactical changes they subsequently made to interventions (organizational learning). Organizational learning was related to changes in maternal and child health behaviors of the women (including changes in the proportion using post-partum care). As the latter result would not have occurred without NicaSalud, we conclude that this inter-organizational network provided added value by instigating organizational learning.


*Keywords:* Networks; NGOs; Safe motherhood; Community; Child health; Social capital; LQAS; Nicaragua

## Introduction

Approximately 529,000 women died globally in 2000 because of pregnancy-related causes (Weil & Fernandez, 1999; Zahr & Wardlaw, 2002). Although access to

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obstetric care is a major way of lowering maternal mortality (Tinker & Koblinsky, 1993), research in developing countries indicates many barriers to care (Chapman, 2003; Weil & Fernandez, 1999). Even when perinatal services are available, women do not always use them. The challenge is to promote appropriate behavior to use services in the presence of danger signs.

Similar behavior change challenges exist for mobilizing mothers to treat infant and child diarrhea. In developing countries a variety of obstacles, including beliefs, impede women from treating infants and children in a timely manner or from seeking appropriate help (Goldman, Pebley, & Gragnolati, 2002). Changing human health behavior is indisputably a difficult task and can be complicated by cultural and logistical barriers (Chapman, 2003; Goldman et al., 2002; Pillai et al., 2003).

Evaluations of health services have tended not to assess associations between behavior change and the strategies that comprise a health intervention. Such analysis is important as it can indicate strategies that ought to receive investment and those which should not. Even rarer are evaluations that examine the impact of a network organization on its members' effectiveness in achieving behavior change (Alter & Hage, 1993). If networks add value above and beyond what is achieved by a single organization, then networks can be important strategy for enhancing community health programs in developing countries. This latter point is important to consider since network secretariats are being used more frequently to build the capacity of member organizations to plan and manage health interventions (Laukamm-Josten et al., 2000; Leburg et al., 2001; Vargas, Valadez, Manda, & Mobley, 2003). *Instead, evaluations of health behavior change in developing countries* have tended to compare the differences between final evaluation values of behavior indicators and their baseline values. Occasionally, control groups are included in the evaluation design to eliminate competing interpretations of results (Campbell & Stanley, 1963; Valadez & Bamberger, 1994).

The two objectives of this paper are to assess: (1) the association of three categories of strategies—physical capital, human capital, and social capital—of a community health program for safe motherhood and child survival with the behavior change achieved by the program, and (2) the added value of a strategy using a network of organizations, which established administrative systems for M&E and organizational capacity building to aid managers to make tactical changes in their strategic interventions and created a context in which organizational learning was easier. This second objective assesses the association of organizational learning with behavior change. As some work has already shown, networks can be beneficial to member organizations (Alter & Hage, 1993). For example, networks can build the capacity of their members and standardize administrative systems such as M&E systems. If networks add value above and beyond what is achieved by a single organization then networks can be an important strategy for enhancing community health programs in developing countries. The example used for this analysis is the NicaSalud Federation located in Nicaragua.

Eight international NGOs established a *network* (NicaSalud) in 1999 to coordinate their response to the aftermath of Hurricane Mitch. NicaSalud's eight international non-governmental organizations (INGO) commenced work in 1999 in Mitch-affected areas. Local NGOs (LNGO) commenced work in 2000. Emergency-related activities ended during October 2001. INGO catchment areas tended to be bigger and have budgets about four times larger than LNGO (Valadez, Campos, & Vargas, 2005). Organizations working in the same municipality did not have overlapping catchment areas. Organizations worked as three regional subnetworks.

The eight INGO and six LNGO members of NicaSalud implemented diverse safe motherhood and child survival interventions. The final evaluation report assessing NicaSalud's work (Campos, Valadez, & Vargas, 2002) indicated considerable behavior change among the mothers in the communities in which NicaSalud worked. For example, in 1 year the proportion of mothers who delivered their babies with a trained clinician increased by 16 percentage points in LNGO catchment areas; the increase in INGO areas over 2 years was 18.5 percentage points. Post-partum visits increased 42 percentage points in 1 year in LNGO areas and 37 percentage points in 2 years for the INGO. In some instances, the LNGO started with much lower proportions than the INGO, making large increases possible.

### *Definitions*

Community health interventions use at least four generic strategies to achieve client behavior change:

1. Mass communication, as in radio programs, fairs, movies or videos, and plays.
2. Investment in physical capital, as in the building of community health huts, equipping health workers with scales for use in growth monitoring, or traditional birth attendants with clean birth kits.
3. Investment in human capital, as in training different kinds of paramedical personnel (*parteras, brigadistas, promotores, etc.*) and having them or health professionals give health education talks to women in their communities during pregnancy and after birth, and/or carrying out house visits and/or community visits

for the purposes of health education or to provide other primary health care.
4. Investment in social capital, as in the formation of various mothers' clubs, women's groups, adolescent groups, men's groups, and/or community health committees/councils.

Although most of the strategies may be self evident, the investment in social capital requires some discussion. Explanation is needed because this term has been used in a variety of ways, sometimes meaning rules of reciprocity, social relationships, trust, and the formation of associations (Adler & Kwon, 2000). In this current study we focus on volunteer, informal groups that emphasize horizontal relationships because they appear to build more trust in Latin American contexts (Booth & Richard, 2001). Just as social capital under certain circumstances seems to facilitate economic development and political democracy, we apply the same logic to argue that social capital is effective in improving clients' use of community health programs. Local institutions act not only to provide information about health resources in the community and emotional support during the perinatal period and during child rearing, but also as social control devices that promote participation in the health care system and changes in health behaviors. But perhaps most critically—informal, volunteer groups build trust which gives a woman more confidence in the health messages she receives, overcoming various misconceptions and fears that suppress the effectiveness of interventions (Chapman, 2003; Goldman et al., 2002).

What kinds of investments can an inter-organizational network make in its member organizations? Two categories are considered in this analysis as they were the principal administrative investments made by NicaSalud.

1. The M&E system was important to NicaSalud. It invested substantial resources to build the capacity of member organizations to measure output and outcome indicators regularly and to use this information to improve their programs. Outputs were tracked quarterly through a management information system (MIS) while outcomes were tracked annually using Lot Quality Assurance Sampling (LQAS) which is discussed in the *Methods* section (Campos et al., 2002).
2. Capacity building of member organizations in new protocols was another important role for NicaSalud. Other than capacity building in M&E, NicaSalud organized trainings in Integrated Management of Child Illness (IMCI), strategic planning, proposal writing and qualitative assessment methods.

Two variables used in this analysis to assess the value added by the network are the amount of *Organizational Learning*, as measured by the number of strategic and tactical changes, and the source of the information about the need for changes. A strategy is the activity carried out such as investing in human capital or in social capital. A tactic is the way a strategy is carried out, e.g., the variety of paramedical personnel trained, or the density of household visits, or the formation of health councils or mothers' clubs. The information source refers to whether the idea for a tactical change occurred because of the M&E system or one of the capacity building efforts of NicaSalud. Experience tells us that usually managers encounter unforeseen problems when implementing interventions; and need to modify the initial plan. The questions are: 'Why do NGOs do to address implementation problems?' 'Do they change their strategy or tactics or do they do nothing?' Additional and more profound questions are: 'Why do they alter their plans?' 'Is the change a result of M&E systems or of some other capacity building or because of other characteristics of the inter-organizational network?'

## Methods

Three separate approaches were used to collected data on (1) behavior change indicators, and (2) indicators of physical, human, and social capital investments, and (3) indicators of organizational learning. The first one consisted of NicaSalud's LQAS M&E system. The second used MIS data to count the number and types of capital investments. The third counted the number of changes managers made to the initial interventions using the LQAS M&E system and other capacity building provided by NicaSalud.

### *Dependent variables*

Behavior change was measured as the difference between baseline and final evaluation values of indicators collected by the project monitoring and evaluation (M&E) system. This system was based on the LQAS method (Dodge & Romig, 1944; Lwanga & Lemeshow, 1991; Robertson, Anker, Roisin, Macklai, & Engstrom, 1997; Valadez, 1991). Each NGO organized their projects into a set of about five supervision areas (SA). An LQA sample of 19 mothers permitted assessment of each SA using statistically determined decision rules. When aggregated, LQAS data are a stratified random sample of an NGO catchment area ($5\ \text{SA} \times 19$ interviews $= 95$), and when the data of all 14 are added together they form a stratified random sample of NicaSalud's entire project area with which coverage proportions with 95% confidence intervals can be

calculated (Robertson et al., 1997). One of the key services performed by NicaSalud was training its members with a standardized manual to use the same LQAS M&E system (Valadez, Weiss, Leburg, & Davis, 2003). In this paper, LQAS judgments for each SA are not assessed. The data for different NGOs are considered in aggregate only—which is why behavior change can be measured. A detailed description of how all these measures were taken as well as baseline, monitoring, and final evaluation data can be found elsewhere (Campos et al., 2002; Valadez, Campos, Leburg, Vargas, & Seims, 2001; Valadez, Campos, Thorndahl, Seims, & Leburg, 2001; Valadez et al., 2005). All data were representative, probability proportional to size random samples of households receiving services from member organizations, and double entered into a computer database to eliminate data entry errors. Although the data collected during the final evaluation contained 27 behavior change indicators, this analysis includes a total of seven behavior indicators. Many indicators were excluded in the analysis because either too few organizations had intervention strategies to affect them or there was an absence of a baseline measure (for further detail see Campos et al., 2002). The seven safe motherhood and child survival behavior change indicators were selected as dependent variables because they maximized the number of member organizations participating in the study and they exhibited the most change during the life of the project (Table 1). The seven indicators covered five intervention areas: antenatal care (ANC), delivery of babies, post-partum care, continuing breastfeeding, and diarrhea case management of children. All indicators with the following exceptions were measured by LQA samples of mothers with children aged 0–11 months. Continuing breastfeeding was assessed with a sample of mothers with children aged 12–23 months. Two indicators, *Using ORT in the Last Diarrhea Episode* and *Taking a Child with Diarrhea to a Health Facility*, were measured with a sample of mothers with children aged 0–23 months who had had diarrhea in the last 2 weeks.

NicaSalud had a total of 16 member NGOs. However, two LNGOs, working exclusively in the area of adolescent sexual education, were eliminated from the study since no other member organizations work in this area. Therefore, the remainder of this paper considers the remaining 14 organizations only. The behavior change measures and standard deviations across the 14 NicaSalud NGOs for the indicators used in this study are found in Table 1.

### *Independent variables*

#### *Protocol*

In April 2002, 4 months after NicaSalud's Hurricane Mitch Recovery programs ended, the authors collected independent variable data (i.e., counted changes to strategies and tactics used by INGO/LNGO in the five interventions areas listed above). They also used interview data to identify factors instigating those changes, and to assess the added value of NicaSalud to these organizations. They intended to identify best practices. All interviews were conducted in Spanish using a structured questionnaire with open responses. The instrument was translated into Spanish by a bilingual English/Spanish (native) speaker. Respondents answered in Spanish which were translated into English by a bilingual Spanish/English (native) speaker. All

Table 1
Indicators of women's safe motherhood and child survival behavior with measures of change

| | Change | Standard deviation[a] |
|---|---|---|
| *I. Safe motherhood: behavior* | | |
| 1. % of mothers of children 0–11 months who have an ANC card | 22.23 | 18.10 |
| 2. % of mothers of children 0–11 months who had 3 or more ANC visits during their last pregnancy | 20.62 | 16.88 |
| 3. % of mothers of children 0–11 months who delivered their baby with a trained clinician | 10.64 | 10.01 |
| 4. % of mothers of children 0–11 months who had a post-partum clinic visit | 15.76 | 9.88 |
| *II. Child survival: behavior* | | |
| 5. % of mothers of children 12–23 months continuing to breastfeed | 15.76 | 9.88 |
| 6. % of mothers of children 0–23 months who had diarrhea in the last 2 weeks who used oral rehydration therapy | 16.41 | 8.49 |
| 7. % of mothers of children 0–23 months who had diarrhea in the last 2 weeks who took their child to a health facility | 41.74 | 23.05 |

[a]The standard deviation is of the different change scores across the 14 NGO members of NicaSalud.

translations were verified by the bilingual native Spanish speaker. These data were then coded using an ipsadive[1] approach (Campbell, 1977; Valadez, 1978). The instrument was originally developed in English because the sociologist on the team who drafted the instrument and who coded the data was not a Spanish speaker. The other authors had extensive work experience in Nicaragua and ensured the questionnaire was relevant for that context.

Three different questionnaires were used: one each for area supervisors (who managed community-level health workers), for line managers (who managed area supervisors), and for senior technical staff of NicaSalud (who built the capacity of member organizations in IMCI, M&E, community health, and who managed the MIS). Two area supervisors were randomly selected from each of 12 member organizations. However, the remaining two LNGO had severely reduced their staff after the projects ended, so only one person was interviewed in each of them. Therefore, a total of 26 supervisory interviews were carried out in the 14 organizations ($[12 \times 2] + 2$). The interview instruments enquired about the tactics used to promote maternal behavior change such as pregnant mothers' clubs, women's clubs, health committees, the training of birth attendants and health volunteers. Also included were questions about when area supervisors began working on the project, the duration of their work, what their activities were, and other details. These interviews generally lasted 30–60 min. Since area supervisors tended to agree and report the same information, the scores within each NGO were averaged.

All 14 line managers were interviewed; on occasions when a line manager left the project prior to the end, the replacement was interviewed and their reports combined. These interviews identified the initial strategies in each of the five intervention areas and any changes in either strategies or tactics and the reasons for the changes. These interviews allowed us to quantify organizational learning as well as other impacts attributed to NicaSalud, as described below. These interviews generally lasted 1 to 2 h.

Two staff members of NicaSalud were interviewed to elicit an oral history of NicaSalud as a network. Output data from the NicaSalud MIS about the number of paramedical personnel trained, the number of health committees formed, the number of house visits, and the like were also incorporated into the data analysis.

[1]The word *Ipsadive* is derived from the word *ipse* as in *ipse dixit* which mean *himself* or *he himself said it*. An Ipsadive method, therefore, is one in which each unique response receives a unique numerical code. Whenever a response is repeated by a respondent, the same numerical code is used again.

*Assessing organizational learning*

In the organizational literature, organizational learning is usually inferred by examining changes in the productivity curve across time. Any improvements are considered a consequence of organizational learning. This approach applied to public health has a number of limitations beyond the problem of inference. Firstly, productivity measures are not readily available in public health programs. Although productivity measures have been developed for hospitals, they are not appropriate here. Secondly, the NicaSalud projects were of short duration, either 1 or 2 years, and this span is not long enough to use the productivity assessment method. Thirdly, in health care projects, one would want to know if the learning was associated with something other than productivity, in this instance, changes in the health behavior of the women. To ascertain this last point, one needs independent measures of the amount of organizational learning or number of tactical changes as well as changes in health behavior.

The assessment of the amount of organizational learning attributable to the NicaSalud Federation was accomplished by counting the number of changes in the initial tactics selected by the organizational members of the NicaSalud Federation. Examples of tactics included in the study are listed in Table 2. The measurement of the initial tactics occurred in each of five intervention areas: ANC, delivery of babies, post-partum care, breastfeeding, and ORT (oral rehydration therapy) preparation. When NGOs attributed changes to NicaSalud's capacity building activities (e.g., training INGO/LNGO to use LQAS, training them in IMCI), then the

Table 2
Total number of INGO/LNGO using four categories of strategies to change behavior

| Generic strategy | INGO (*N*) | LNGO (*N*) | Total |
|---|---|---|---|
| *A. Mass communication* | | | |
| Radio, fairs | 3 | 1 | 4 |
| Film, theater | 1 | 2 | 3 |
| *B. Physical capital* | | | |
| Health clinics/posts/huts | 8 | 2 | 10 |
| Birth attendants equipped | 3 | 1 | 4 |
| *C. Human capital* | | | |
| Talks with women | 5 | 6 | 11 |
| Paramedical personnel | 7 | 6 | 13 |
| Mother's aides | 4 | 6 | 10 |
| Household visits | 6 | 6 | 12 |
| Training of health personnel | 7 | 6 | 13 |
| *D. Social capital* | | | |
| Mothers' or women's groups/clubs | 7 | 3 | 10 |
| Health committees | 7 | 4 | 11 |
| Total | 8 | 6 | 14 |

learning was credited to NicaSalud. Interviewees revealed a variety of sources of organizational learning, allowing us to determine when an organization changed its tactics.

*Statistical analysis*

The dependent variables were calculated as the amount of health behavior change produced in 1 year by LNGO or in 2 years by INGO. The change scores for each organization were computed by subtracting indicator baseline values from the final evaluation value. In the few instances where the change score was negative, a zero was recorded, meaning no positive change.

Since INGO interventions were twice as long as those of LNGO, changes recorded by LNGO were multiplied by two, assuming that the same level of change would have occurred in the second year if the program continued 1 more year. This allowed us to analyze all the member organizations together. Without this adjustment statistical analysis would have been impossible due to the small number of organizations. Sensitivity analyses were carried out to judge the effects of weighting. Reanalysis without weighting produced similar results.

The independent variables include three of the four generic strategies presented earlier (i.e., physical, human and social capital). Mass communication was not included in the study since too few organizations used this strategy to permit analysis. Since LNGO and INGO had different size budgets related to the number of communities in which they worked (Valadez et al., 2005), relevant independent variables were standardized by the population in the catchment area of the member organization. Independent variables not requiring this correction were those unaffected by population size, such as the variety of health education talks, the variety of paramedical personnel trained and the number of strategic and tactical changes (i.e., the amount of organizational learning). All independent variables were rounded to whole numbers. Any organization not using a particular strategy or tactic was coded as 0.05 to preserve the organization in the analysis.

For INGO/LNGO the strength of association between the independent and dependent variables (i.e., the amount of behavior change) was measured with a *Pearson correlation* coefficient. Every organization was a separate data point in the analysis. Due to the small number of organizations ($n = 14$) available for assessment, computations were made with *StatXact-5* statistical software developed for use with small sample sizes. Multivariate analyses (such as multiple regression analyses) were not feasible due to the small dataset. Statistical significance was tested using a one-tail test to test hypotheses that capital investments (i.e., physical, human and social) or organizational learning are positively associated with behavior change.

To assess synergies amongst independent variables (which typically would have been included in multiple regression analyses), we multiplied independent variables together. However, as zero-order effects were not in the equations it was not possible to determine which explained more variance in behavior change. In those interactions where one strategy was not used by a particular organization, one was used as a multiplier to conserve the value of the remaining independent variable. This decision also preserved the number of organizations used in the analysis. Using different values (e.g., 0.1 or 0.5) did not change the results.

The following analyses focus on behavior *change*. Lack of a statistically significant correlation does not mean that a substantial amount of change did not take place. Rather, it means that the selected independent variables do not explain the measured change.

## Results

*Independent variables: generic strategies*

All four generic strategies were used by INGO/LNGO. Most organizations used several strategies. Each strategy includes several tactical variations listed in Table 2. These tactical variations can be further subdivided into a number of categories such as length of training of paramedical personnel, who did the training, duration of a household visit, who made the visit, the number of times the same health care message was provided in household visits and/or radio spots, fairs and other forms of mass communication. The small number of INGO/LNGO using mass communication interventions prevented us from including this generic strategy in the analysis. The remaining three strategies were used by at least 10 organizations, and are, therefore, included in this analysis because we could be certain of having enough data for statistical analysis.

*Dependent variables: safe motherhood behavior change*

Correlation coefficients with $p$-values $\leqslant 0.10$ are reported (Table 3). Blank cells indicate correlations coefficients with $p$-values $> 0.10$.

The physical capital investment (*density of health huts*) was associated with *3+ ANC Visits* ($r = 0.59, p = 0.05$) which suggests the importance of having a venue for woman to have reproductive health consultations with paramedical personnel promoting antenatal clinics. Of the human capital investments the density of paramedical personnel exhibited an association with mothers retaining an ANC card ($r = 0.56, p = 0.05$). The variety of paramedical personnel was correlated with *ANC Card Retention* and *3+ ANC Visits* ($r = 0.52, p = 0.03$;

Table 3
Behavior associations with intervention strategies and organizational learning in NicaSalud: safe motherhood

| Independent variable | Behavior | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| (Letters following independent variables identify those used in interaction terms | 3+ ANC visits | | ANC card retention | | Delivery with a clinician | | Post-partum visit | |
| Statistically significant results at $p \leqslant 0.10$ are presented only) | $r$ | Exact $p$ | $r$ | Exact $p$ | $r$ | Exact $p$ | $r$ | Exact $p$ |
| *Physical capital* | | | | | | | | |
| Density of community health huts built (A) | 0.59 | 0.05 | | | | | | |
| *Human capital* | | | | | | | | |
| Density of health talks (B) | | | | | | | | |
| Variety of types of paramedical personnel trained (C) | 0.60 | 0.02 | 0.52 | 0.03 | | | 0.76 | 0.02 |
| Density of paramedical personnel (D) | | | 0.56 | 0.05 | | | | |
| Density of household visits (E) | | | | | | | | |
| Mothers para-aides (F) | | | | | | | | |
| *Social capital* | | | | | | | | |
| Density of health committees/councils (G) | 0.59 | 0.03 | 0.59 | 0.03 | | | | |
| Density of mothers' or women's clubs/groups (H) | | | | | | | | |
| *Interactions* | | | | | | | | |
| Physical capital × human capital (A × C) | 0.70 | 0.01 | 0.49 | 0.06 | | | | |
| Physical capital × human capital (A × D) | 0.64 | 0.03 | 0.70 | 0.05 | | | | |
| Physical capital × human capital (A × E) | 0.76 | 0.01 | | | | | | |
| Physical capital × human capital (A × G) | 0.70 | 0.02 | 0.60 | 0.03 | | | | |
| Human capital × human capital (C × D) | 0.66 | 0.02 | 0.82 | 0.01 | | | | |
| Human capital × social capital (C × G) | 0.74 | 0.01 | 0.68 | 0.01 | | | | |
| Human capital × human capital (D × E) | 0.53 | 0.05 | 0.64 | 0.03 | | | | |
| Human capital × social capital (D × G) | 0.57 | 0.05 | 0.71 | 0.03 | | | | |
| Human capital × social capital (E × G) | 0.71 | 0.02 | 0.67 | 0.02 | | | | |
| *Organizational learning and value added* | | | | | | | | |
| Strategic and tactical changes (for corresponding intervention) | 0.47 | 0.08 | | | | | 0.67[a] | 0.05 |
| | | | | | | | 0.49[b] | 0.10 |

[a]Correlation is with ANC tactical changes only.
[b]Correlation is with post-partum tactical changes only.

$r = 0.60, p = 0.02$, respectively). The former is an indicator of ANC access as a pregnant woman receives a card during her first visit, while the latter is indicative of appropriate ANC use. The variety of paramedicals was also associated with women having *Post-Partum Visits* to clinicians ($r = 0.76, p = 0.02$), a result which may underscore the importance of community health personnel to reinforce *Post-Partum Visit* recommendations women receive during ANC visits.

Of the social capital investments, the density of health committees in the communities was correlated with both ANC *Card Retention* and *3+ ANC Visits* ($r = 0.59, p = 0.03; r = 0.59, p = 0.03$, respectively). These results suggest the importance of having local leaders legitimize the efforts of paramedicals and health workers carrying out household visits. This interpretation was supported when interaction terms were created using the density of health committees and both forms of human capital. Both interactions were strongly associated with *ANC Card Retention* ($r = 0.71,\ p = 0.03; r = 0.67, p =$ 0.02, respectively) and *3+ ANC Visits* ($r = 0.57, p = 0.05$; $r = 0.71, p = 0.02$, respectively).

By itself the density of household visits was not associated with any behavior change. But when combined with physical capital investment (density of health huts) it exhibited a correlation of 0.76 with *3+ ANC Visits*. The bivariate correlation for health huts was only 0.59. Furthermore, in combination with the densities of paramedicals and health committees, it produced a significant result for *3+ ANC Visits* ($r = 0.53, p =$ $0.05; r = 0.70, p = 0.02$, respectively) and improved the correlation with *ANC Card Retention* ($r = 0.64, p =$ $0.03; r = 0.60, p = 0.03$, respectively). We conclude that it is necessary to study interactions or combinations of variables to understand synergistic effects.

There was a major non-finding. Although large amounts of behavior change had occurred for the indicator *Mothers Delivering A Baby With A Clinically Trained Provider*, no meaningful associations were detected with any form of physical, human or social capital. An analysis of the residuals for this correlation reveals that organizations that had a higher than average amount of behavior change for this indicator were located in urban areas and the Pacific Northwest where geographical access to health care is easier. In contrast, where the amount of change was below average, the organizations were located in mountainous and remote regions where access to health services was poor—a well-known effect (Chapman, 2003).

Further analysis revealed that post-partum visit behavior change was correlated with an increase in delivery with a clinician ($r = 0.52, p = 0.08$). Despite this association, increases in *Delivery With A Clinician* was inversely related to mothers being in a remote area ($r =$ $-0.56, p = 0.07$), whereas *Post-Partum Visits* behavior change exhibited no statistically significant association ($r = -0.02, p = 0.46$) with location. These results may suggest that once a woman delivers her baby with a clinician, she is also likely to have a post-partum visit regardless of where she resides. However, living in a remote area may mitigate against women delivering babies with a clinician in the first place.

Also, neither the post-partum nor delivery behavior change indicators were correlated with either of the ANC behavior changes, suggesting that changes in ANC-related behaviors and delivery/post-partum-related behaviors may be affected by different phenomena. Such a result is not uncommon. For example, a recent assessment in Uganda revealed that while 92% (sd = 4%) of women in districts studied attended ANC, substantial variation existed in where they delivered their babies. Districts ranged from 29.6% to 94.9% of deliveries with clinicians (Mukaire, Kisitu, Ssekamatte-Ssebuiliba, & Valadez, 2004).

Another factor that may explain why there are no significant positive relationships amongst these strategies is that as the health care system was rebuilt after Hurricane Mitch, and the institutional capacity of the Ministry of Health's clinics was strengthened, they became more desirable place for women to deliver babies and seek post-partum care, resulting in more women using these services. This may be why the post-partum visit behavior change is related to delivery with a clinician. However, given the earlier results another interpretation is that INGO/LNGO successfully promoted ANC care, the initial contact with the health system. Once the contact was established a group of women used it for delivery and post-partum care while another group did not.

*Dependent variables: child survival behavior change*

Investment in building health huts was associated with mothers giving ORT to their children in their last diarrhea episode ($r = 0.46, p = 0.06$) and in referring them to a clinic during the episode ($r = 0.47, p = 0.06$) (Table 4). This may be due to mothers having access to ORS (oral rehydration salts) sachets and information about how to treat children with diarrhea at the health hut.

An interesting difference with the safe motherhood analysis is that mothers' child survival behaviors were not associated with human capital investments. However, social capital investments exhibited significant results. For example, women's club density had a strong association with *Taking A Child With Diarrhea To A Health Facility* ($r = 0.74, p = 0.00$). The density of health committees was associated with a mother *Giving ORT* to her child during the most recent diarrhea episode ($r = 0.51, p = 0.05$).

Of the child survival behavior indicators, *Continuous Breastfeeding* alone exhibited no association with the various intervention strategies. However, human capital

Table 4
Behavior associations with interventions strategies and organizational learning in NicaSalud: child survival

| Independent variable | Behavior | | | | | |
|---|---|---|---|---|---|---|
| (Letters following independent variables identify those used in interaction terms | Continuing breastfeeding | | ORT given during diarrhea episode | | Child with diarrhea taken to health center | |
| Statistically significant results at $p \leqslant 0.10$ are presented only) | $r$ | Exact $p$ | $r$ | Exact $p$ | $r$ | Exact $p$ |
| *Physical capital* | | | | | | |
| Density of community health huts built (A) | | | 0.46 | 0.06 | 0.47 | 0.06 |
| *Human capital* | | | | | | |
| Density of health talks (B) | | | | | | |
| Variety of types of paramedical personnel trained (C) | | | | | | |
| Density of paramedical personnel (D) | | | | | | |
| Density of household visits (E) | | | | | | |
| Density of women aides in the community (F) | | | | | | |
| *Social capital* | | | | | | |
| Density of health committees/councils (G) | | | 0.51 | 0.05 | | |
| Density of mothers' or women's clubs/groups (H) | | | | | 0.74 | 0.00 |
| *Interactions* | | | | | | |
| Physical capital × human capital (A × B) | | | 0.52 | 0.04 | | |
| Human capital × social capital (B × G) | | | 0.55 | 0.03 | | |
| Human capital × social capital (B × H) | | | 0.46 | 0.07 | 0.83 | 0.00 |
| Social capital × social capital (F × H) | 0.55 | 0.06 | | | 0.54 | 0.04 |
| *Organizational learning and value added* | | | | | | |
| Strategic and tactical changes (for corresponding intervention) | | | 0.59[a] | 0.04 | | |

[a]Correlated with breastfeeding strategic and tactical changes.

(mothers para-aides) in combination with the social capital investment in mothers' clubs ($r = 0.55, p = 0.06$) revealed a positive correlation. This is an interesting result as the two are closely related and may reinforce each other.

With one exception, the four interactions (Table 4) exhibited higher correlations than the bivariate analyses. In all interactions, human capital was a salient component. This finding is interesting since all human capital investments exhibited no significant result for child-health-related behavior change, and may suggest that investments are most effective in combination with appropriate physical or social capital, or with other human capital investments.

Three of the four interactions involved the density of health talks. The density of health talks in combination with the density of health huts, or the density of mothers' clubs, or the density of health committees, was associated with mothers *Giving ORT* to their child during their last diarrhea episode. The combination with mothers' clubs was also strongly associated with mothers taking their child with diarrhea to a health center ($r = 0.83, p = 0.00$). Again, the emergence of the importance of human capital variables in interactions underlines the importance of studying combinations of strategic interventions.

*Independent variable: values added by the network due to organizational learning*

The number of strategic and tactical changes were counted for each intervention of each INGO/LNGO. But before these can be considered to be value-added to the NicaSalud investments, the source of the change has to be determined.

Structured interviews revealed two primary sources of information that managers attributed to organizational learning. Firstly, the LQAS M&E system provided each INGO/LNGO manager with information about the performance of each management unit in specific geographical locations. This information permitted them to identify the strategy that had substandard performance and the geographical location of the problem. Secondly, INGO/LNGO met in regional sub-networks to share their LQAS results, develop joint solutions, and share best practices and lessons learned (Campos et al., 2002; Valadez et al., 2005). A third, but less important source of information came from capacity building events—such as IMCI training. Interviews revealed that the predominant catalyst for organization learning was the LQAS M&E system. This was the case regardless of whether data were used individually by organizations or in regional sub-networks.

An example of a tactical change comes from diarrhea case management interventions. During the second use of LQAS, the INGOs noted that mothers were not using ORT as expected. Immediately following the monitoring, INGOs changed program tactics and began to include ORT promotion along with other health education. They also provided litre containers with the ORT recipe printed on the side. This information was shared in regional network meetings.

*Dependent variables: safe motherhood and child survival behavior change*

This section investigates associations of the amount of organizational learning (the number of strategic and tactical changes) with behavior changes (Tables 3 and 4). Among the safe motherhood behavior indicators, organizational learning was associated with mothers having had *3+ ANC Visits* ($r = 0.47, p = 0.08$). This result suggests that changing the strategies and tactics of interventions by themselves is strongly associated with behavior change, albeit less than any single intervention. However, we note our inability to control for different variables in multiple regression analyses due to the small number of organizations in the study. Nevertheless, this result suggests that when local managers have information about their program's performance, they can use it to effectively make improvements that increase impacts.

One of the most interesting findings concerns the change in *Post-Partum Visits* by mothers. Although the number of tactical changes in interventions focusing on post-partum visits was associated with this behavior change ($r = 0.49, p = 0.10$), another strong association was detected. The number of tactical changes to interventions promoting *ANC Visits* was correlated with increased proportions of mothers having *Post-Partum Visits* ($r = 0.67, p = 0.05$, respectively). These results may suggest that enhancements of ANC may increase the likelihood of women seeking post-partum services. This is an interesting result given that one of the typical aims of ANC is to advise women to seek post-partum care.

Organizational learning was also associated with changes to the child health behavior indicator *Giving ORT To A Child In Their Most Recent Diarrhea Episode* ($r = 0.59, p = 0.04$).

This is a stronger zero-order correlation than any single intervention or combinations of interventions. Our interpretation is as above: local managers can effectively use M&E information about their organization's performance to improve impacts on behaviors change by changing tactics.

## Discussion

At the most general level, this paper is a case study of one inter-organizational network organization with 14 NGO member organizations in Nicaragua. Also, it demonstrates the utility of collecting systematic data on

both behavior change and the various strategies designed to change behavior. However, the results have important public health implications as they are suggestive of tactics practitioners may use to plan programs aimed at changing women's health behaviors.

The purpose of this paper was to analyze the relative effects of investments made by separate INGO/LNGO in their own interventions and those made by a network organization, in this case NicaSalud. The former included investments in physical, human and social capital as strategies of behavior change, while the latter included the LQAS M&E system and various forms of capacity building as ways of adding value to the efforts made by the individual INGO/LNGO.

This section assesses these investments in terms of **best practices**. Taken individually, three strategies are strongly associated with changes in ANC-related health behavior of women: physical capital (*density of health huts*), human capital (*density and variety of paramedical personnel)*, and social capital (*density of health committees/councils)*. The only strategy that impacted on three of the four indicators of safe motherhood behavior change was the variety of paramedical personnel trained—a result that recommends a systematic as well as a diverse approach to training. Combining several of the human capital tactics, whether the variety of paramedical personnel trained or the density of paramedicals or the density of household visits, improves the bivariate correlations of the three strategic interventions: physical, human, and social capital. Again, this is an argument that for safe motherhood, a broad gauged systematic community intervention is more likely to be effective.

In contrast, two strategies are strongly associated with changes in the diarrhea case management behavior of mothers: physical capital (*density of health huts*), and social capital (*density of health committees/councils, density of mothers' clubs*). With mother's child health behavior change, combinations of strategies are slightly more effective in general. Surprisingly none of the human capital tactics were associated with this area of maternal behavior change. However, in combination with physical and social capital, the human capital investments exhibited significant effects. These synergies are most evident in continuous breastfeeding behavior change, as the only association is the interaction of the density of mother aides (human capital) and the density of mother clubs (social capital). These results suggest that for child survival behavior change, human capital investments should be considered jointly with physical and/or social capital investments.

When we shift from the discussion of the similarity and differences of the effectiveness of various strategies to the comparison of the tactics within each of these strategies, the differences between what changes safe motherhood behavior and child survival behavior are much sharper and suggestive. For safe motherhood behavior change, the most prevalent tactic is the social capital investment, density of health committees, which appears in 10 correlations. The density of paramedical appears in nine correlations followed by variety of personnel trained and the density of health huts (eight correlations each). However, the strongest correlation was exhibited by the interaction of the variety and density of personnel (human capital). In child survival, the strongest association was the density of health talks (human capital) *combined* with the density of mothers clubs (social capital). However, the tactics with the strongest correlations included the density of health talks (human capital) followed by the densities of health huts, and health committees and mothers clubs. Human capital tactics exhibit strong associations only in combinations. Whereas, physical and social capital appear in bivariate analyses as well as in combinations.

Thus, the reasoning used to select investments in physical, human, and social capitals are quite different. Reasons for the differences may have to do with the nature of the behaviors involved. Reproductive health services require the personal attention of paramedicals being with clients in private settings to discuss their physical status (e.g., ANC services), whereas managing a child's diarrhea can often be done without privacy. Mothers consult each other about their children. As a result, safe motherhood behavior may require individual effort by health workers to change behavior as compared to child survival behavior. In the former case women have to leave their communities to receive ANC in a health facility. The personal support of paramedicals in health huts, promoting the use of ANC and deliveries of babies with clinicians may be important strategies. In child health, mothers clubs and health talks may provide sufficient support and instruction to mothers when their child has diarrhea. Health huts are important as supply points for ORS sachets.

Although *Household Visit* density alone did not display a significant association with behavior change for either safe motherhood or child health behavior change, in combination with the density of health huts, paramedicals and health committees, it exhibited strong correlations with ANC behavior change—results that may signal women's preference to discuss their reproductive health in privacy. The interaction of strategies produced stronger correlation than either strategy produces alone—suggesting that one should not look for *silver bullets* but rather better understand the synergies of interventions.

Assessments of the added value of networks also revealed best practices. One of the more interesting set of findings was derived from the analysis of the association of the number of strategic and tactical changes made by each organization with each selected intervention. The changes were referred to as *Organiza-*

*tional Learning* because the strategic and tactical changes were motivated by capacity building activities of NicaSalud. The prominent activity was training in the use of the LQAS M&E system. For safe motherhood behavior change, organizational learning exhibited more diverse associations than any capital investment, being correlated with both ANC and post-partum behavior change—which no capital investment did alone. It also exhibited one of the strongest correlations with the child survival behavior change variable, giving ORT to a child with diarrhea. One important hypothesis derived from these results is that a network creates an environment in which organizations are more likely to use their M&E system results to manage themselves than the organization would do without the sharing of information. The more they appropriately use the information the better the effect. Thus, an important best practice is the use of a network—especially to train member organizations to use M&E and discuss results in a group context. In the case of NicaSalud, the group context occurred in two ways. Firstly, within each organization supervisors of each LQAS SA shared results and lessons learned. This experience provided a context for making strategic and tactical changes. Secondly, within regional sub-network organizations shared results. This context also provided a stimulating context to share lessons and foment tactical change.

At the most general level, the importance of this study is that different strategies are associated with changes in both safe motherhood and child survival maternal behavior. Single interventions at times have strong associations, but in some instances, it is the combination of strategies that exhibit stronger associations. One of the more interesting conclusions about health behavior change is that certain combinations may act as substitutes for single strategies, thereby providing INGO/LNGO with choices depending upon their own ideology and their own knowledge base about what they do best. However, in this regard, the variety and density of paramedical personnel trained, the density of health huts, health committees and household visits appear to be essential elements either alone or in combinations. As we accumulate more studies, we can began to explain in more detail why this may be so as well as develop better knowledge about how to make these interventions more effective.

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