



Activity Report 137

Combining Hygiene Behavior Change with Water and Sanitation: Monitoring Progress in Hato Mayor, Dominican Republic

Part II

(December 2001–March 2004)

June 2004

by Robert Kolesar, Eckart Kleinau, Marco Polo Torres, Candida Gil,
Victoria de la Cruz, and May Post (July 2003)

with update and revisions by

Eric Johnson, Flady Cordero, and John Gavin (June 2004)

Prepared for the Office of Health, Infectious Diseases and Nutrition,
Bureau for Global Health, U.S. Agency for International Development,
under EHP Project 26568/CESH.DR.Y5

Environmental Health Project
Contract HRN-I-00-99-00011-00
is sponsored by the
Office of Health, Infectious Diseases and Nutrition
Bureau for Global Health
U.S. Agency for International Development
Washington, DC 20523

Contents

Acronyms.....	v
Acknowledgements.....	vii
About the Authors.....	ix
Executive Summary.....	xi
1. Introduction.....	1
2. Background.....	5
3. Methodology.....	9
3.1. Participatory Monitoring Approach.....	9
3.2. Target Population.....	9
3.3. Sample Design.....	9
3.4. Questionnaires.....	10
3.5. Organization and Logistics.....	12
3.6. Personnel Training.....	12
3.7. Data Tabulation and Entry.....	12
4. Limitations of Study.....	13
5. Results.....	15
5.1. General Demographic Characteristics.....	15
5.2. Diarrhea Prevalence.....	16
5.3. Drinking Water.....	17
5.4. Handwashing.....	19
5.5. Excreta Disposal.....	24
5.6. Sanitation Hygiene.....	25
5.7. Hygiene Training of Children.....	27
5.8. Community Hygiene Promoters.....	27
5.9. Payment for Services.....	29
6. Summary of Findings.....	31
7. Conclusions.....	33
References.....	36

Acronyms

CHP	Community Hygiene Promoter
CRS	Catholic Relief Services
DHS	Demographic and Health Surveys
DIGPRES	Secretariat of Health's Department of Health Promotion
EHP	Environmental Health Project
INAPA-AR	National Water Authority's Department of Rural Aqueducts
MOH	Ministry of Health
MUDE	Dominican Women in Development
NGO	Non-governmental Organization
PAHO	Pan American Health Organization
PAHO	Pan-American Health Organization
SESPAS	Secretariat of Public Health and Social Assistance
SSID	Social Services of Dominican Churches
STI	Sexually Transmitted Infection
TCP	Total Community Participation
USAID	United States Agency for International Development
WHO	World Health Organization

Acknowledgements

The authors thank everyone in the Dominican Republic who assisted in the implementation of the survey and ensured that the data were of the highest quality possible. We are especially grateful to the institutions that supported this effort by providing high-quality counterpart staff, technical expertise and vision in order to make this survey and its corresponding formative research and community-level interventions possible. These institutions are the Secretariat of Public Health's Department of Health Promotion (DIGPRES), National Water Authority's Department of Rural Aqueducts (INAPA), Catholic Relief Services (CRS), Dominican Women in Development (MUDE) and Social Services of Dominican Churches (SSID) (both local NGOs), Peace Corps, Pan-American Health Organization (PAHO) and the United States Agency for International Development (USAID).

The authors particularly acknowledge the USAID/DR Mission. USAID/DR contributions were cited as a motivating and driving force throughout the course of the project for the planning and implementation of the hygiene behavior change activities in the Dominican Republic in addition to taking an active/hands-on role during the monitoring events, which is the subject of this report.

The authors also acknowledge the efforts of Sandra Callier, Kelva Perez, Merri Weinger and May Post who served as reviewers of the various drafts of this report (July 2003 and June 2004 versions). Their suggestions contributed to the overall quality of this document.

Finally, it is important to recognize that the behavior changes and health effects that this survey attempts to measure are the results of the tireless work of a team of 23 volunteer community health promoters committed to improving the health of their children, families and communities.

About the Authors

Robert Kolesar, M.P.H., has over 12 years experience with program management, development and community organization. He has worked with USAID on primary health, water and sanitation programs as well as food aid. Mr. Kolesar has expertise in program development, assessment, monitoring, evaluation and quality assurance.

Eckhard F. Kleinau, M.D., Dr.P.H., has 20 years experience as a manager and consultant in public health and primary care programs in the United States, Europe, Africa, Latin and Central America. and Asia. Presently, he is Senior Technical Director at the Environmental Health Project (EHP) for JSI in Arlington, Va., and is responsible for the development and implementation of appropriate methods and standards to evaluate environmental health programs, including systems that provide information for strategic planning and management. In addition, Mr. Kleinau has specific expertise in economic analysis, health care financing, modeling and forecasting, quality assurance and quality management.

Marco Polo Torres, M.A., has over two decades experience as a program and project communication and social marketing specialist and consultant, university instructor, and author in the field of health communication and social marketing. Currently, he is the Social Marketing Advisor at the Manoff Group. Mr. Torres has applied his knowledge, experiences and skills in social marketing to promote behavior changes in various health and environmental areas.

Candida Gil, M.D., is currently the Health, Water and Sanitation Program Manager with Catholic Relief Services in the Dominican Republic. She has extensive experience with health promotion. Previously she worked on the national strategy and communications program for the promotion of breastfeeding with the Dominican Secretariat of Public Health and Social Assistance (SESPAS) in the Department of Maternal and Child Health. Ms. Gil also served for seven years as the Municipal Director of Health for the MOH. She has worked as a consultant for hygiene behavior change in Latin America.

Victoria Cruz, B.A., is the Deputy Director of Mujeres en Desarrollo (Women in Development) a Dominican NGO. She has worked with Mujeres en Desarrollo for over 12 years. Her work has included community organizing, health project management and public relations. Ms. Cruz has also worked as a consultant for hygiene behavior change in Latin America.

May Post, M.D., D.P.&T.M., has over 20 years experience in international health and has worked for a variety of international organizations — USAID, UNICEF, World Bank, DfID — as well as for national ministries of health in Burma, Liberia and Gambia. She joined EHP as the Information Center Coordinator in July 2000. Before joining EHP/Washington, she was a consultant at EHP/Nepal in Kathmandu. She has strong writing skills and has written a range of technical papers and reports covering

primary health care, reproductive and maternal health, and HIV/AIDS/sexually transmitted infections related to women's health. As the current EHP Information Center Coordinator, she works as a member of the EHP project management team. She supervises and coordinates the Information Center staff and consultant editors, is responsible for ensuring the quality of EHP publications, and provides overall guidance and direction in the implementation of EHP's information dissemination strategy.

Eric Johnson, BA, has been involved in the fields of small-scale, rural water supply, sanitation, and alternative energy use for the past 15 years. He has been extensively involved in the training of professionals, technicians, and community leaders throughout Latin America. During the last four years, he has served as a representative of EHP in the Dominican Republic, aiding in the implementation of several components of USAID funded institutional assistance to the national rural water supply agency there. He has also recently served as an advisor providing guidance on economically rational use of renewable energy under funding granted by the U.S. Department of Energy.

Flady F. Cordero, MA, has three decades of experience in development work in the Dominican Republic and other areas of Latin America. He has served as a consultant to more than 10 national and international NGOs, and has carried out work as a project evaluator for the European Union and other agencies. He holds a BA in Political Science and has done additional graduate work in the same discipline. Mr. Cordero is currently the coordinator of the EHP promotion and skillbuilding activity for hygiene behavior change methodology in the Dominican Republic.

John Gavin, BS, MURP, is an experienced project manager with a technical background in small scale water and sanitation infrastructure and has been involved in development projects in Latin America, North Africa, the Middle East, and Eastern Europe over the last 15 years. He worked as the Chief of Party in the final stages of the two-year Hurricane Mitch/EHP Rural Water, Sanitation and Hygiene project in Nicaragua. He is currently managing EHP hygiene behavior change projects and handwashing initiatives in Nicaragua, Peru, the Dominican Republic and Nepal.

Executive Summary

This monitoring report is an update to EHP Activity Report (AR) 120, of the same title, published in July 2003. AR 120 focused on the comparison of data from household surveys conducted in December 2001 (baseline) and May 2002 (first midterm survey). This report updates AR 120 to include the comparison of results from two subsequent household surveys, June 2003 (second midterm survey) and March 2004 (final survey). Two complementary reports are: (1) EHP Activity Report 125, “Combining Hygiene Behavior Change with Water & Sanitation: A Pilot Project in Hato Mayor, Dominican Republic,” which describes the larger hygiene behavior change pilot project from April 2000 through May 2002; and (2) EHP Summary Activity Report, pending publication, which will update AR 125 and include hygiene behavior change activities managed by EHP in the DR, through April 2004.

The approach for the hygiene behavior change activities in Hato Mayor involved a process that included (adapted from Torres and Bendahmane, et al., 2004):

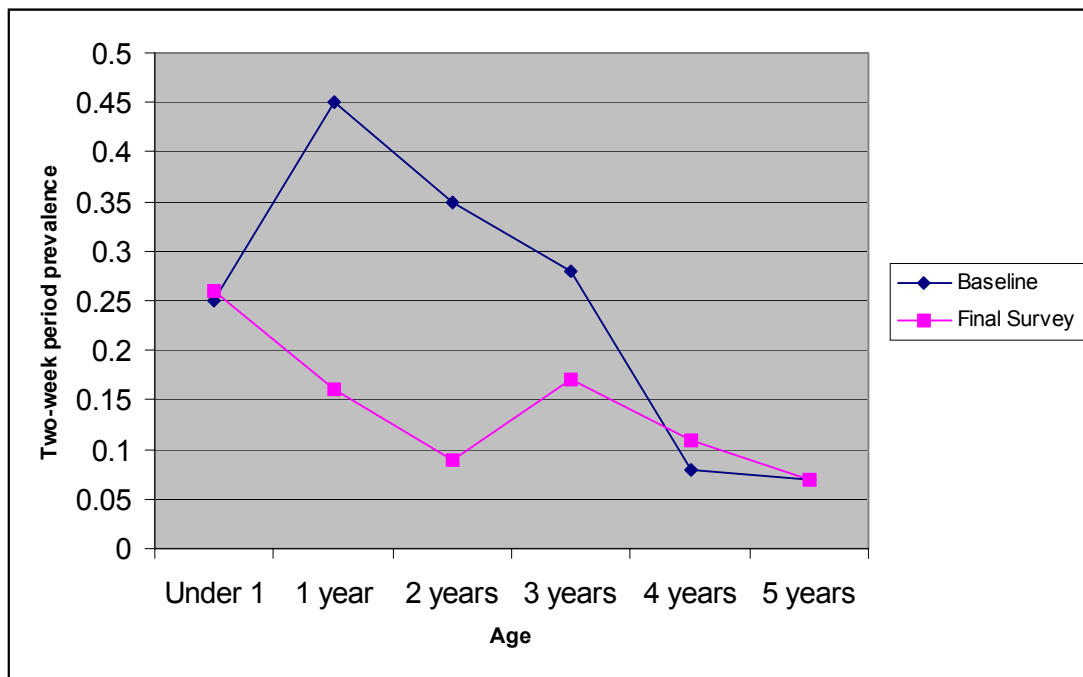
- Qualitative or formative research to identify behaviors that need improvement, and obstacles to adoption of those behaviors
- Health promoter training concentrating on practical communication, negotiation and interpersonal skills — an approach focusing on changing behaviors, not merely on increasing knowledge
- Baseline assessment/quantitative research (knowledge, attitudes, practices) focusing on the behaviors to be addressed and for follow-up assessments
- Community involvement in developing the strategy, identifying the target behaviors, producing and testing educational materials, implementation, and conducting periodic assessments

A key aspect of the implementation phase was regular, periodic household visits by the Community Hygiene Promoters (CHPs). The CHPs worked with the primary child caregivers in the household, who are predominantly women, to negotiate and agree upon the improved hygiene practice(s) of the household. Monitoring and reinforcement of the negotiated hygiene behavior changes occur during subsequent home visits as households advanced toward their objectives.

The process was modified for implementation in Peru and Nicaragua and is described in a forthcoming EHP Joint Publication 7, “Improving Health through Behavior Change: A Process Guide on Hygiene Promotion,” along with a CD-ROM containing sample graphic materials, survey instrument, focus group discussion (FGD) guide and other resource materials.

Between December 2001 and March 2004, four household surveys were conducted to measure the results of a hygiene behavior change programming process in nine communities of the municipality of Hato Mayor in the Dominican Republic. The

purpose of these surveys was to provide NGO program managers and communities with timely information about changes in diarrhea prevalence and hygiene behaviors before and after water and hygiene interventions were introduced. The surveys were part of the process and could be characterized as “participatory monitoring” — requiring the involvement of the inter-institutional team that initiated the infrastructure and hygiene activities and who served as an active participant in a systematic process of ongoing community level data collection with community members themselves and the Community Hygiene Promoters (CHPs). Such organizational participation is essential to build and maintain stakeholder buy-in. Although the purpose of the surveys was programmatic — that is, they were not intended as a scientifically rigorous program evaluation — taken together they provide a clear picture of a combined hygiene behavior change and health hardware intervention. A total of 109 households were covered at baseline and approximately 125 households in the later surveys designed to monitor trends and sustainability of observed changes after one and two years of program interventions.



Graph 1. Two week period prevalence of diarrhea by age: baseline and final surveys

Of the 165 children under five years of age included in the baseline sample of December 2001, 27% were reported to have had diarrhea within the previous two weeks. More than two years later, this fell to 13% for the 197 children included in the final survey conducted in March 2004. While this decrease may be attributable to the program interventions, it could possibly also reflect seasonal variations.

Of the 165 children under five years of age included in the baseline sample of December 2001, 27% were reported to have had diarrhea within the previous two weeks. More than two years later, this fell to 13% for the 197 children included in the final survey conducted in March 2004. While this decrease may be attributable to the program interventions, it could possibly also reflect seasonal variations.

Graph 1 illustrates the differences in period prevalence of diarrhea by age at baseline and final survey. The largest changes were recorded among children between the ages of one and three. A spike in illness can be seen for children at age one at baseline with a less pronounced spike for three year olds in the final survey.

Most of the hygiene behaviors promoted as part of the intervention showed statistically significant improvements from the time of baseline to the first follow-up survey. In subsequent surveys, second midterm survey of June 2003 and final survey of March 2004, the results varied with some behaviors showing signs of backsliding.

For reported handwashing at critical times, the most significant improvements occurred for handwashing “after going to the bathroom” and “before eating.” For the first midterm survey, there were increases in handwashing after going to the bathroom that were reported by the primary caregiver (a 12% improvement) for herself and the youngest child (a 16% improvement). In the final survey, the improvement over baseline was 8% and 12%, respectively. Handwashing before eating rose from 33% at baseline to almost 50% in the second midterm survey (June 2003) and remained at that level for the final survey. This may be demonstrative of the emphasis given to handwashing after going to the bathroom and before eating by the Community Hygiene Promoters (CHPs).

Use of soap improved from 59% to 79% in the first midterm survey but declined to a midpoint of 69% in the final survey. Demonstrated handwashing technique, while showing significant improvement in the first midterm survey, showed a decline by the final survey. Handwashing demonstrations showed a proportion of respondents who rubbed their hands together three or more times improved from 49% to 72% at first midterm but declined to 43% at final survey. In surveys following the initial baseline, hand-drying technique seemed to show sustained improvement with 97% observed in final survey following recommended practice compared to 20% at baseline.

These findings seem to indicate that some behaviors, once changed, may not require additional promotion. Behaviors which improved in early surveys that returned to baseline levels in subsequent surveys would seem to indicate the need for supplemental, more sustained, or a different type of reinforcement.

The main objective of the surveys was to reinforce the work of the CHPs by quantifying the changes that are plausibly associated with their efforts. The “witnessing of visible changes” and a sense of accomplishment have been cited as effective incentives to motivate Community Health Workers (Bhattacharyya et al., 2001). At the community level, the success and sustainability of the project rests with the continued promotion and negotiation of improved hygiene practices by CHPs.

CHP participation and motivation strategies were central considerations at every stage of the project. Participatory monitoring using repeated household surveys was an authentic effort to empower local implementing NGOs. This has to be taken into account when interpreting the findings presented in this report.

Over the duration of the implementation of the Hato Mayor pilot, the CHPs experienced different levels of support, starting from a very high level at the outset (with training and direct supervision) but tapering off through the course of the project, especially during the last year leading up to the final survey in March 2004. This may be a factor in the decline of some behaviors in the later surveys. Also, the precipitous decline in economic stability experienced in 2003/2004 may have distorted or diminished the significant improvements recorded during the primary project period of December 2001 through May 2002. The erosion of purchasing power, as much as 50%, over this short period could have resulted in a reduction of purchases of practical “behavior-change enabling items” like soap, toilet paper, and hand towels.

Finally, this study and its corresponding hygiene behavior change intervention are the results of an impressive inter-institutional effort. Nine institutions, including two Dominican government agencies, three NGOs, one multi-lateral and three bi-lateral organizations, came together to make it possible. This collaborative enterprise has created a sense of ownership on the part of all stakeholders and is demonstrated by continued commitment and work to scale up to the national level. Such participatory approaches to project implementation can serve as a model to achieve impact, scale and sustainability.

1. Introduction

Hygiene behavior change was introduced to the Dominican Republic in 2000 through USAID funded technical assistance as part of the Hurricane Georges Reconstruction Initiative. Sixteen NGOs, the Secretariat of Public Health (SESPAS) and the National Water Authority (INAPA-AR) participated in an intensive EHP training course that included behavior change theory and methodology as well as experiential field application. Following this training, a core team was formed to carry out the completion of a rigorous formative research project in hygiene behavior change. The team's work culminated with the development, field testing and implementation of a community-based hygiene behavior change strategy in nine communities in the municipality of Hato Mayor. This work is described in a complementary EHP Activity Report 125, which describes project activities between April 2000 and May 2002. A third phase of the activity, June 2002 through April 2004, which includes an expansion of Hygiene Behavior Change activities, both geographically and organizationally in the Dominican Republic, will be documented in a forthcoming EHP publication.

Hato Mayor is located in the central-eastern section of the Dominican Republic, approximately three hours from the capital city of Santo Domingo. The nine communities included in this study are characterized as rural and poor. The communities are Libonao, La Mora, Vasquez, El Coco, El Mamón, Jaqueta, Bambu, Mango Limpio and Kilometro 15. They are dispersed geographically, but culturally homogeneous. Prior to the project, Hato Mayor's sanitation coverage was abysmally low, with less than 10% of the households in the target communities having access to adequate sanitation. Likewise, water supply in these communities was not safe or adequate. Residents collected water in buckets and cans from nearby rivers and surface springs or from the more distant sugar processing plants.

The nine communities of Hato Mayor were targeted for the hygiene behavior change intervention as they were just beginning work on water and sanitation pilot projects. These jointly funded USAID/INAPA-AR projects were designed to demonstrate the Total Community Participation (TCP) model. This model focuses on mobilizing community involvement to achieve sustainability for rural water and sanitation programs. The hygiene behavior change intervention was added to maximize the potential health effect. To date, participatory monitoring using two consecutive household surveys was part of an inter-institutional effort to incorporate hygiene behavior change into these pilot projects.

The objective of the baseline and later monitoring surveys conducted in 2002, 2003, and 2004 was to measure the outcomes resulting from the implementation of integrated hygiene, water and sanitation interventions among selected households in

nine communities of Hato Mayor. The hygiene intervention was implemented by Community Hygiene Promoters trained in hygiene behavior change. They used didactic materials that were developed as part of the formative research component of the overall project. The community-level hygiene intervention focused on the promotion of six macro-behaviors, encompassing 42 micro-behaviors. The macro-behaviors included:

1. maintenance of uncontaminated drinking water supply
2. latrine use for children over three years of age
3. latrine use by all family members
4. use of potties for children under three followed by the appropriate disposal of feces in the latrine
5. handwashing at critical moments (after using the latrine, before eating, after changing diapers, before food preparation and before serving food)
6. promotion of a permanent place for handwashing

The behavior-change approach to hygiene used in the Dominican Republic pilot project involved: Qualitative or formative research to identify the behaviors that need improvement as well as the obstacles to adoption of those behaviors and possible motivating forces; Baseline assessment/Quantitative research (knowledge, attitudes, practices) focusing on the behaviors to be addressed and for follow-up assessments; Community involvement in developing the strategy, identifying the target behaviors, producing and testing educational materials, and conducting periodic assessments; Health promoter training concentrating on practical communication, negotiation and interpersonal skills, rather than on transmitting specific messages or concepts and most important, an approach focusing on changing behaviors, not merely on increasing knowledge (Torres and Bendahmane, et al., 2004).

A key aspect of this process utilized negotiation through a consultative process between the health/hygiene promoters and community members – primarily women as primary caregivers. In a review of improved behaviors, a series of behaviors were identified (including current behavior), with the ideal behavior appearing at the end of the sequence. The negotiated discussion resulted in the establishment of household goals that were an improvement of current practices and were feasible and achievable, though not necessarily the “ideal” behavior. Through this process, incremental improvement of key behaviors was achieved. This process was further refined for planning and implementation of pilot projects in Peru and Nicaragua, which are scheduled for completion in June 2004. The process itself is described in a forthcoming EHP Joint Publication 7, “Improving Health through Behavior Change: A Process Guide on Hygiene Promotion.”

The hardware components in the overall project were simple water supplies with domestic yard-tap distribution, and dry sanitation using either VIP latrines or double

vault composting latrines (where high water tables made the VIP model unfit). The formative research component is documented in EHP Activity Report 125, which describes in detail the project under which the surveys were conducted, and the water and sanitation interventions are recorded in more detail in the Final Program Reports of Catholic Relief Services and Women in Development (MUDE).

The data that is presented in this report is considered to be participatory monitoring in that the inter-institutional team that initiated the water, sanitation and hygiene activities is participating in the systematic process of the ongoing community level data collection. Such organizational participation is essential to build and maintain stakeholder buy-in.

The results of participatory monitoring have three intended uses:

1. as a monitoring tool for program managers and communities to identify accomplishments and challenges of the hygiene behavior change intervention to fine tune future field work
2. as feedback for the community-level volunteer Hygiene Promoters to motivate their continued work by demonstrating their accomplishments and quantifying their results
3. as confirmation of the importance and potential of hygiene behavior change for local stakeholders to continue efforts to scale up this activity to the national level

The value of the participatory monitoring approach, or the resources and coordination required to successfully utilize it, should not be underestimated. It typically requires skill building in evaluation methodology, data collection, and analysis for participants, but it also serves as motivating factor for the participants who are real members of the team as well as community members who are the focus of attention.

The baseline survey data collection was conducted the first week of December 2001. Additional evaluation surveys were in May 2002, June 2003 and March 2004. It is important to recognize that the hardware interventions were at different stages of completion and operation throughout the nine communities at the time of the baseline survey. Therefore, all comparisons of data between the baseline and follow-up surveys reflect the combined effect of improved access to water and sanitation as well as hygiene education.

2. Background

In developing countries, diarrhea accounts for the deaths of nearly 1.6 million children under five every year — or almost 15% of all deaths for that population. (WHO, 2003). In 2000, diarrhea claimed more than 37,000 lives in Latin America and the Caribbean (PAHO, 2001).

Diarrhea prevalence in the rural areas of the Dominican Republic remained constant at 16% according to the authoritative 1996 and 1999 Demographic and Health Surveys (DHS). The Dominican Secretariat of Public Health has reported that diarrhea is the leading cause of death nationwide (2002). Children who survive may contend with other health effects. Diarrhea significantly contributes to protein-energy malnutrition, which in turn can seriously effect childhood growth and development (Berger and Esrey, 1995).

Diarrheal disease prevention requires a comprehensive, integrated approach. EHP's diarrhea prevention strategy, known as the Hygiene Improvement Framework has three core components: access to hardware, hygiene promotion and promoting enabling environments (Figure 1). By blocking the pathways to contamination (the first two components) and promoting sustainability (the third), this model offers a comprehensive framework for designing, implementing, and evaluating programs to fight diarrhea.

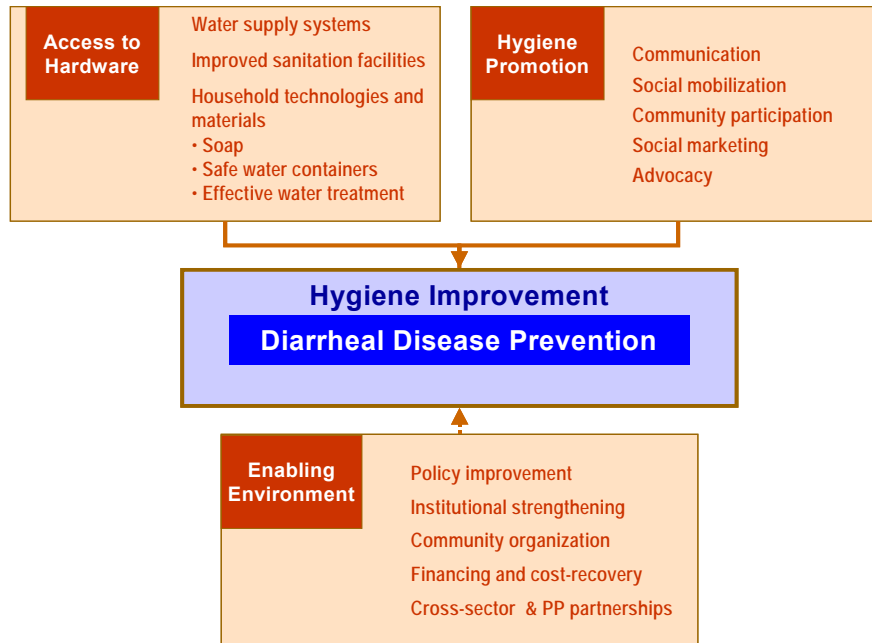


Figure 1. Hygiene Improvement Framework

An important component of the Hygiene Improvement Framework is hygiene promotion. Cost-effectiveness estimates of hygiene promotion range from \$0.20 to \$11.20 per diarrhea case averted (Varley, 1998). This low-tech intervention consistently demonstrates significant reductions in diarrhea prevalence; a literature meta-analysis found that a single hygiene practice — handwashing with soap — is able to reduce diarrhea incidence by over 40% (Curtis and Cairncross, 2003).

Hygiene promotion also reinforces the third component of the Hygiene Improvement Framework by empowering communities through organization and participation. This is a critical approach to creating an enabling environment and achieving sustainability. “Participation and influence are considered essential for developing effective [health] programs and more importantly are considered health promoting in and of themselves” (Baker and Brownson, 1999).

The World Health Organization defines health promotion as “the process of enabling people to increase control over and to improve their health” (WHO, 1986). Through the negotiation of improved hygiene practices at the household level, families are empowered with knowledge and skills. Community elected volunteer Hygiene Promoters are the change agents responsible to their communities for facilitating improved health. Monitoring of those improvements can reinforce positive behavior changes and motivate CHPs to continue their work. “For health professionals concerned with community organizing and community building for health, there are two reasons for the imperative placed on effective ... health assessment: information is needed for change, and it is needed for empowerment” (Hancock and Minkler, 1997).

The first two components of the Hygiene Improvement Framework work together to disrupt the transmission of micro-organisms that cause diarrheal disease. Hygiene promotion leading to improved hygiene practices (e.g., handwashing) and access to hardware (e.g., water and sanitation) succeed in blocking different fecal transmission routes. The F-diagram presented by Kawata, illustrates the pathways of fecal exposure and corresponding opportunities to interrupt transmission. Pathogen exposure is reduced, which leads to a decrease in diarrheal disease and improved nutrition absorption. These intermediate outcomes mutually support a decrease in mortality and morbidity.

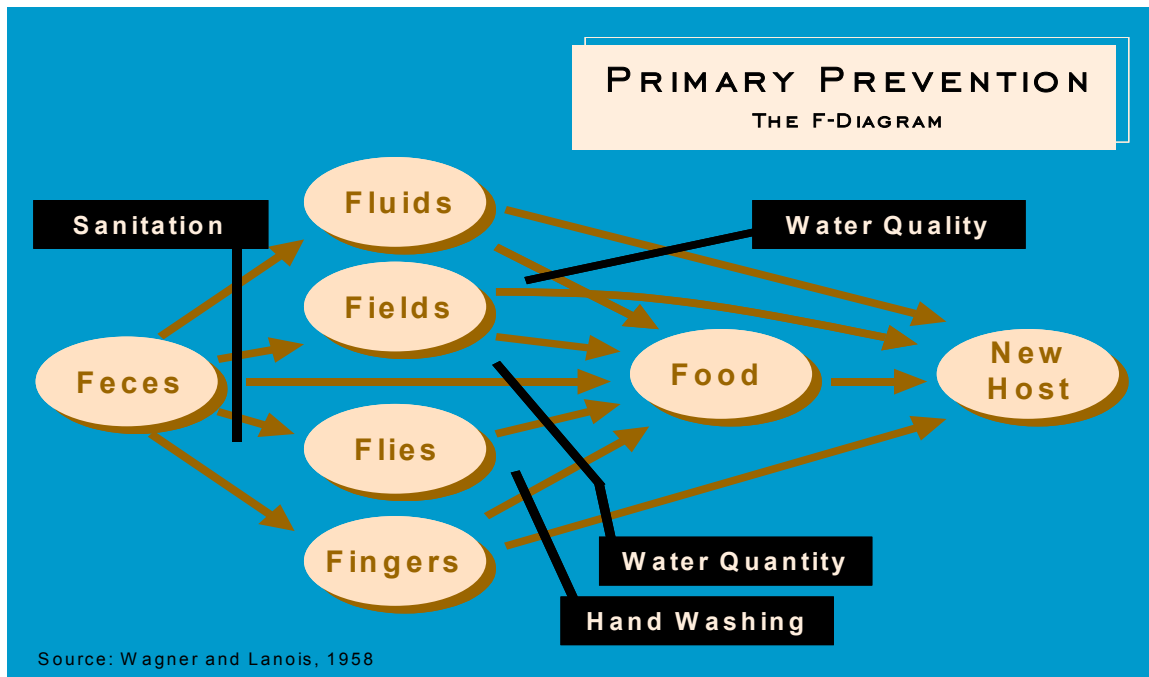


Figure 2. Primary prevention and routes of possible transmission of disease from feces

While research supports this transmission/prevention framework (Esrey et al., 1991; Kolsky, 1993; Han et al., 1989; Haggerty et al., 1994), there is still considerable debate concerning the best hygiene promotion strategy. Some studies suggest that targeting a single behavior such as handwashing is likely to produce the largest impact on health status (Huttly et al., 1997; Curtis and Cairncross, 2003). In contrast, a case-control study in rural Bangladesh demonstrated interaction between water supply (hand pumps) and hygiene education. These interventions were shown to produce significant drops in children’s diarrhea after three to four hygiene activities were practiced together (Alam et al., 1989).

While this issue remains unresolved, there is consensus that high levels of fecal exposure, often present in heavily contaminated environments, may limit the effectiveness of controlling only one or two routes (Briscoe, 1984; Kolsky, 1993). This has been attributed to the “threshold-saturation theory,” which suggests that “at

the lower end of the spectrum, there is a threshold below which investments in community water and/or excreta disposal facilities alone result in little detectable improvement in health status” (Shuval et al., 1981).

Despite the increase in knowledge of how to improve health, the solution requires political will and economic capital in order to expand access. Currently, rural access to potable water and sanitation is disconcertingly low in the Dominican Republic.

Table 1. Water, sanitation and diarrhea in the Dominican Republic by urban and rural residence

Region	Percentage of population without access to potable water services	Percentage of population without access to sanitation	Percentage of children under five with reported diarrhea in the previous two weeks
Urban	16.9	4.4	15.4
Rural	49.3	21.3	17.9

Sources: PAHO 2000; DHS 1999

Table 1 shows the dramatic difference in access to water and sanitation between the urban and rural areas. This difference, however, is not reflected in the diarrhea prevalence rate between the areas. This could be explained by the threshold saturation theory discussed previously. That is, although the urban areas have better access to water and sanitation, high levels of environmental fecal exposure may increase transmission. Hand-to-mouth transmission is generally not interrupted by water and sanitation alone — handwashing is required.

These data highlight the need for expansion of hygiene education in order to maximize the health benefits to those with access to water and sanitation and to mitigate the negative health consequences of those without access. This study provides support to the concept that integrated water, sanitation and hygiene education programs can be successfully implemented in the Dominican Republic and can produce a significant reduction in diarrhea prevalence.

As part of the participatory monitoring process, data were collected to allow communities, CHPs and other stakeholders to examine changes in diarrhea prevalence as well as reported and observed behaviors relating to drinking water storage, handwashing and latrine use. The surveys also collected some basic demographic data of the selected households.

3. Methodology

3.1. Participatory Monitoring Approach

Participatory monitoring as implemented in the nine pilot communities in the Dominican Republic consisted of four household surveys that were administered over a two plus year period. The baseline survey (December 2001) was implemented before hygiene promotion intervention began, and the first mid-term survey was implemented five months post-intervention (May 2002) to quantify initial changes that may be attributable to the program. The first mid-term survey was followed by a second midterm survey (June 2003) and a final survey (March 2004).

3.2. Target Population

The target population consisted of selected households with children under five at the time of the baseline survey in nine rural communities of the municipality of Hato Mayor, Dominican Republic. The communities are Libonao, La Mora, Vasquez, El Coco, El Mamón, Jaqueta, Bambu, Mango Limpio and Kilometro 15. This universe was selected in order to measure outcomes of integrated hygiene, water and sanitation interventions among selected households of communities participating in the pilot projects managed by Catholic Relief Services (the first five communities) and Women in Development (the last four communities).

3.3. Sample Design

The sample was designed using a weighted-quota to ensure participation from all project communities. The total sample size was calculated using a simple random sample calculation multiplied by the design effect. However, households were not selected at random but included consecutively until the quota was met. The total number of children under five to be included in the survey was calculated at 135.

The total proportion of children under five needed for the sample was 35% of the total population under five years of age. This proportion was applied to each community in order to establish a proportional representation. The number of households interviewed in each community is detailed below.

Table 2. Children under the age of five years and quotas by community

Community	Under 5 Census	Rounded Quota
Libonao	23	8
La Mora	24	8
Vasquez	19	7
El Coco	39	14
El Mamon	36	13
Jaqueta	33	12
Bambu	49	17
Mango Largo	42	15
Kilometro 15	120	42
Totals	385	135

There were 109 households interviewed at the baseline, 13 of which were households with elevated-composting latrines. There were 125 households (in first midterm) and 126 households (in second midterm and final) included in the later surveys, 16 of which were additional households to capture the particular behaviors that were promoted for households that constructed elevated-composting latrines in communities where none existed at baseline. To the greatest degree possible, the same households were visited during the baseline and mid-term surveys, with the exception of the 16 additional households with composting latrines in the latter.

3.4. Questionnaires

Both the baseline and mid-term questionnaires consisted of 60 questions and 18 structured observations. A supplemental questionnaire was developed and applied to households with an elevated-composting latrine. The supplemental consisted of 11 questions (ten for the first mid-term) relating exclusively to elevated-composting latrines.

Both instruments were field tested in two rural communities that had similar characteristics to the nine communities of Hato Mayor.

Several changes were made to the mid-term evaluation survey in order to improve the instrument's validity and collect additional information, while eliminating questions that were not considered useful (e.g., in cases when several interviewees reported that they questioned the respondents truthfulness). A section on contact and interaction with the community health promoter was added to the second and subsequent surveys. This was not included in the baseline as the promoters did not become active until after the baseline was completed.

Both questionnaires are annexed. Those questions that were substantially modified have not been used in the analysis of this report. However, these questions may be useful for measuring changes between the mid-term and future monitoring surveys.

A structured observation using a checklist was completed for each interviewee. She was asked to demonstrate washing her hands. Water manipulation, use of soap, number of times hands were rubbed together and drying technique were recorded. Additionally, water storage and latrine structure and cleanliness were also observed by the interviewer.

Both questionnaires collected information on the following:

1. Socio-demographic/Diarrhea prevalence
 - Household composition
 - School facilities
 - Presence and type of community organizations
 - Diarrhea prevalence within the last two weeks
2. Drinking Water Storage
 - Observed storage
 - Drinking vessel
 - Washing practices
3. Handwashing
 - Critical moments — primary care taker
 - Critical moments — child
 - Facilities
 - Peripherals (soap, towel and water)
 - Observed skills (use of soap, rubbing hands together and use of towel)
4. Sanitation and Feces Disposal
 - Time of ownership of a sanitation facility
 - Sharing of latrine
 - Observed structure and cleanliness
 - Elevated- composting latrine only:*
 - Latrine use
 - Knowledge of proper maintenance
 - Acceptability
 - Related practices
 - Observed cleanliness
5. Water Supply Sustainability

Access

Participation

Payment

First Mid-term and subsequent surveys:

6. Contact with health promoter
 - Themes discussed
 - Number of visits
 - Commitment to make a behavior change
 - Receptivity to visits

3.5. Organization and Logistics

The organization and logistics of the field level data collection were the same for all surveys. Two inter-institutional teams were formed to complete the field level data collection. Each team consisted of eight interviewers and one supervisor. The teams were comprised of NGO staff and representatives from the Ministry of Health as well as the Rural Aqueduct Department of the National Water Authority. Community Hygiene Promoters collaborated in the identification of households with children under five. Each questionnaire required approximately 25 minutes to complete.

Supervisors randomly monitored interviewers for quality assurance, and feedback was provided when appropriate.

Both field teams participated in coordination and debriefing meetings, which were held each night following the first two days of data collection. Both teams returned to the capital upon completion of the data collection on the third day.

3.6. Personnel Training

All interviewers had previous experience with community level data collection and survey interviewing. They received eight hours of training in the use of the questionnaire. The training was carried out by the field supervisors. A field manual was elaborated by the primary researcher and the field supervisors. This manual defined and standardized interviewing procedures.

3.7. Data Tabulation and Entry

Data was entered, processed and summarized using EPI-INFO Version 6.4. The results of this analysis are presented in Chapter 5 Results.

4. Limitations of Study

There are a number of limitations to the study design. First, no pre-hardware baseline was established due to time constraints resulting from funding restrictions. Therefore, analysis and measurement of the impact of water and sanitation interventions independent from the hygiene behavior change activity is not possible.

Because the sample of households was not selected at random, but used a quota approach, statistical tests are biased (of unknown magnitude). This also limits the ability to generalize beyond households included in the sample to the entire population in pilot communities. Although unlikely, households that were selected for inclusion in the surveys may have somehow been systematically different from households that were not included.

The participatory monitoring process did not include a control group for practical and economic reasons. Because all of the interviewed households were in project communities, there is no non-intervention group with which to compare observed changes. In the absence of a control group, conclusions about the extent to which changes are attributable to interventions are tenuous.

An effort was made to interview the same households in each survey, but the population in the survey communities is not stable, and migration made it necessary to substitute households at times.

Although the majority of the interviewed households at baseline were included in the later surveys (with the exception of the 16 additions discussed above), no coding system was used to be able to link the baseline and following surveys by household. Such a coding system would have permitted a more rigorous data analysis (using paired sampling tools) in addition to allowing a comparison of changes in diarrhea prevalence by household with and without water at baseline. Moreover, repeat visits to households increase the Hawthorn effect — people may change their responses and behavior according to what they perceive as desirable when they are observed and interviewed.

Changes to the questionnaire could compromise the validity and reliability of the modified questions. Such questions may not be measuring the same information from the baseline to the mid-term survey and, therefore, have been excluded from this report. Some of these changes are discussed above.

The level of involvement of the NGOs and direct supervision of the hygiene promoters dropped off after the first midterm survey in May 2002. During the project period in 2002, the collaborating NGOs maintained no less than bi-monthly contact

and support to the promoters. After the project period (from 2003 onward) the NGOs attempted to keep a line of support open, but at the contact level of once every six months. It was anticipated that more direct NGO involvement would taper off as the NGOs faced new priorities in their other program areas and regions. The NGOs that did participate in the Hato Mayor pilot did so without direct funding or support from EHP other than for the monitoring events themselves. While maintaining a visible and supportive presence after the primary implementation phase may be a common problem, the specific emphasis on follow-up of certain behaviors (the ones suffering from highest degree of erosion) would seem to be an efficient use of limited or declining resources. In other words, instead of focusing supervised follow-up and monitoring on all behaviors, focusing on behaviors that take longer to become habits may make the most sense. For example, handwashing technique may have benefited from targeted promotion.

Additionally, some of the water systems suffered breakdowns by the time of the later surveys, undermining the ability of household members to carry out desired behaviors.

Finally, external factors occurring in 2003 and 2004 may have distorted or diminished changes recorded between December 2001 and May 2002. After a decade of relative economic stability, in 2003 the Dominican Republic suffered a rapid decline in the value of its peso. Purchasing power was eroded by as much as 50% in this short period, possibly affecting the capacity of surveyed project households to sustain purchases of practical “behavior-change enabling items” like soap, toilet paper, and hand towels.

5. Results

This chapter presents the summary data collected from the baseline and the three follow-up surveys. Unless indicated otherwise, chi-squares were calculated on the summary data between the December 2001 baseline and the first midterm survey in May 2002 to test for statistical significance. This was done for a better interpretation of observed differences between the baseline and at least one of the follow-up surveys. Because of the limitations of the participatory monitoring process explained in the previous section the results from these statistical tests have to be interpreted with caution. Even so, P-values less than .05 are generally considered statistically significant. What this means is that if we were to re-survey the households in the nine communities 100 times, the true population proportion would be included in approximately 95 of the sample-based confidence intervals. About five of the 100 surveys would be expected to yield erroneous interval estimates outside the true population proportion. The two-sided Fisher's Exact Test was used to determine p-values wherever recorded cases were less than five. P-values indicating statistical significance are reported in bold.

For the primary targeted result, incidence of diarrhea in the under age 5 population, a highly significant decline from 27% at baseline to 13% at final survey was reported. Similar significant patterns of change were reported for many, but not all, of the key targeted behavior changes.

5.1. General Demographic Characteristics

The mean household size at baseline was 5.9. The primary caregiver of children under five was most often the mother: 73% at baseline; 81% at final survey . Following the mother as primary caregiver was the grandmother with 24% at baseline and 16% at final survey. Sisters and other family members were also cited as primary caregivers for the remaining households. All respondents reported that their community had a school. Fifty-four percent of households reported to belong to a community organization by the mid-term survey. This fell to 40% by the final survey. Of those reporting such membership, over half cited belonging to a neighborhood association, 20% stated they were part of a women's committee, and 18% reported to belong to the water committee. These levels of membership for the neighborhood association and women's committee were stable through the final survey, but membership in the water committee fell substantially, to just over 8%.

5.2. Diarrhea Prevalence

The desired health effect from water, sanitation and hygiene behavior change interventions is a reduction in diarrhea prevalence. At baseline, households were asked about diarrhea prevalence within the past two weeks for all children under five living in the household; this question was repeated in the later surveys. Information on children who turned five after the baseline was collected in order to include the same cohort in the surveys.

Table 3. Percentage of children with diarrhea by age

Age yrs.	Baseline Dec-01			Follow-up May-02			Follow-up Jun-03			Final Mar-04			P-value Dec-01 to May 02
	N	# cases	% cases	N	# cases	% cases	N	# cases	% cases	N	# cases	% cases	
<1	8	2	25	6	36	17	29	9	31	19	5	26	0.62
1	42	19	45	6	24	25	17	12	71	37	6	16	0.1
2	31	11	35	6	42	14	29	5	17	46	4	9	0.03
3	32	9	28	3	27	11	27	7	26	30	5	17	0.019
4	24	2	8	2	38	5	28	1	4	38	4	11	0.64
5	28	2	7	1	42	2	15	0	0	27	2	7	0.56
Total	165	45		24	209		145	34		197	26		0.0001
Avg %			27			11			23			13	

The first midterm survey showed the most promising results with an overall decrease of diarrhea prevalence of 16% (from 27% to 11%). The decrease was also experienced across all age groups. The second midterm, while still less than the baseline, at 23%, showed *increases* from baseline for some age groups, most dramatically for one year olds, at 71% compared to 45% at baseline. By the final survey, in March 2004, the overall diarrhea prevalence was back down to 13% with declines for one, two, and three year olds. Two age groups (under ones and five year olds) returned to baseline level (26% and 7%, respectively) and one age group (four year olds) increased slightly to 11% from 8% at baseline. The two year olds showed the most sustained decline across all surveys. Excepting second midterm survey results for one year olds, the decrease in incidence was most significant across surveys for the one and two year old groups and for the group taken as a whole.

Stratification by age with diminished sample size reduced the power of the individual year findings, which may explain the lack of statistical significance for some years. The largest decreases in diarrhea prevalence occurred for children between the ages of one and three by the final survey. One important consideration is the possibility of seasonal diarrhea fluctuations between the months in which the surveys were conducted with a baseline in December, first midterm in May, second in June, and final in March. Although seasonal epidemiological data is not available to empirically

support this possibility, anecdotal reports from key informants suggests that diarrhea rates are highest in the Dominican Republic during the April/May rainy season. The rainy season often extends into June in the southern Dominican Republic, and the survey coordinator noted that the June 2003 survey was conducted during a rainy spell.

Though uneven, the overall decrease in diarrhea prevalence from 27% at baseline appears sustainable over time, with the final survey average diarrhea prevalence of 13% recorded in March 2004 close to the average diarrhea prevalence of 11% recorded in May 2002. (see Table 3).

5.3. Drinking Water

5.3.1. Primary water source

At baseline, 34% (not shown) of the households reported having access to a community water system. All of these households were located in the two communities where the water systems had been completed by the hardware component of the project. By the May 2002 survey, all nine communities had new water systems (including rain water catchment), and all households reported access. Chart 1 illustrates the primary drinking water source as of May 2002, which is the same in subsequent surveys. Some of the community water systems experienced breakdowns in 2003 and 2004 that were not immediately repaired, leading to a disruption of improved water supply service.

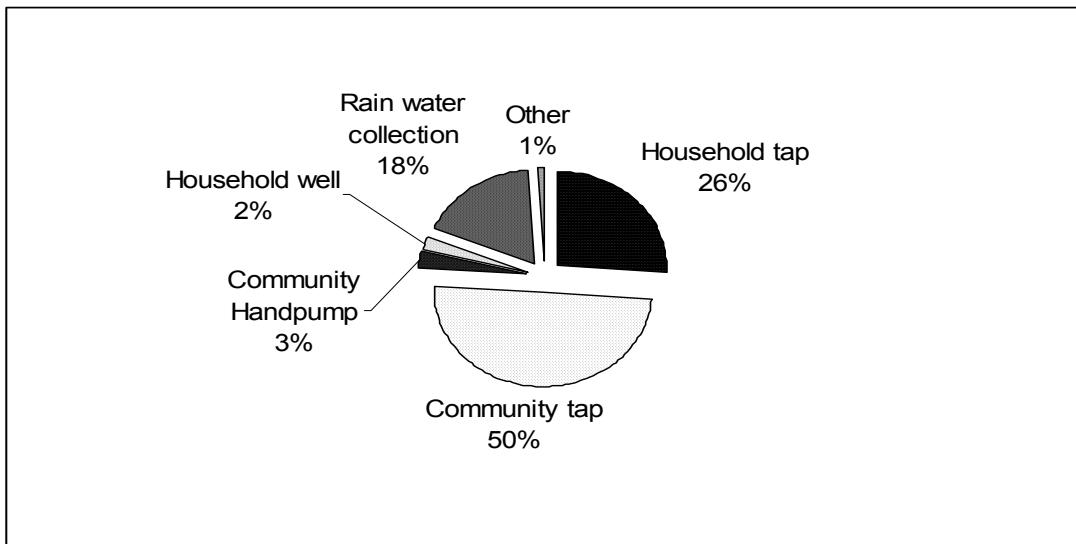


Chart 1. Primary water source after implementation of community water systems (first mid-term survey)

5.3.2. Presence and type of water storage vessel

Interviewers observed the presence and type of a water storage vessel. Other than the introduction of buckets with spigots, the primary types of vessels reported in use remained stable throughout the observation period. Likewise, there was no change in type of supplies (detergent, chlorine, soap, etc.) used to clean the water storage vessel.

Beyond the presence of a water storage container, an evaluation of the data on storage container type is complicated by a lack of a clear and notable trend. In the second midterm survey and final survey, a high percentage of “unknowns” are indicated at 13% and 24%, respectively, which may be the cause for the absence of a clear trend.

There was no separate category for a large container with spigot in the baseline questionnaire, but it was included in subsequent surveys. Among households with water storage vessels, 13% had a large container with spigot at the first midterm, only 1% were reported with them at the second midterm, which increased to 8% by the final survey. Again the large percentage of “unknowns” in the second midterm and final surveys may be skewing results. The project did include a small-business component, which established a revolving fund to offer families large (five gallon) containers with covers and spigots. The purpose of the revolving fund was to facilitate the acquisition of improved water storage containers beyond early adopters. The fund was exhausted shortly after the first midterm survey. With available data, it is difficult to determine if the facilitation of access to large containers with spigot had any real impact on their presence within the homes.

Table 4. Presence and type of water storage vessel

	Dec-01		May-02		Jun-03		Mar-04		P-value
	N=109		N=125		N=121		N=125		
Presence of water storage vessel	#	%	#	%	#	%	#	%	Dec-01 to May-02
Yes	100	92	117	94	108	89	117	94	0.59
No	9	8	8	6	13	11	8	6	
Type of vessel (for HH with water storage vessels)	N=100		N=116		N=104		N=117		
<i>Bucket-like container</i>	47	47	69	59	67	64	68	58	0.06
<i>Large container w/spigot</i>	*	*	15	13	1	1	9	8	
<i>Water vase</i>	17	17	12	10	9	9	3	3	0.15
<i>Gallon jug</i>	10	10	12	10	7	7	5	4	0.93
<i>Glass bottle</i>	1	1	3	3	3	3	4	3	0.39
<i>Other</i>	21	21	5	4	3	3	0	0	0.0002
<i>Unknown</i>	4	4	0	0	14	13	28	24	

(*) = unknown

5.3.3. Household treatment of drinking water

Respondents were asked if they treat their water. At the first midterm, 45% reported treating their drinking water. For those reporting that they treat their drinking water, 77% cited the use of chlorine as the treatment. By the final survey, those reporting that they treated their water rose to 54%, and the proportion of those treating their water who used chlorine rose to 87% (see Chart 2).

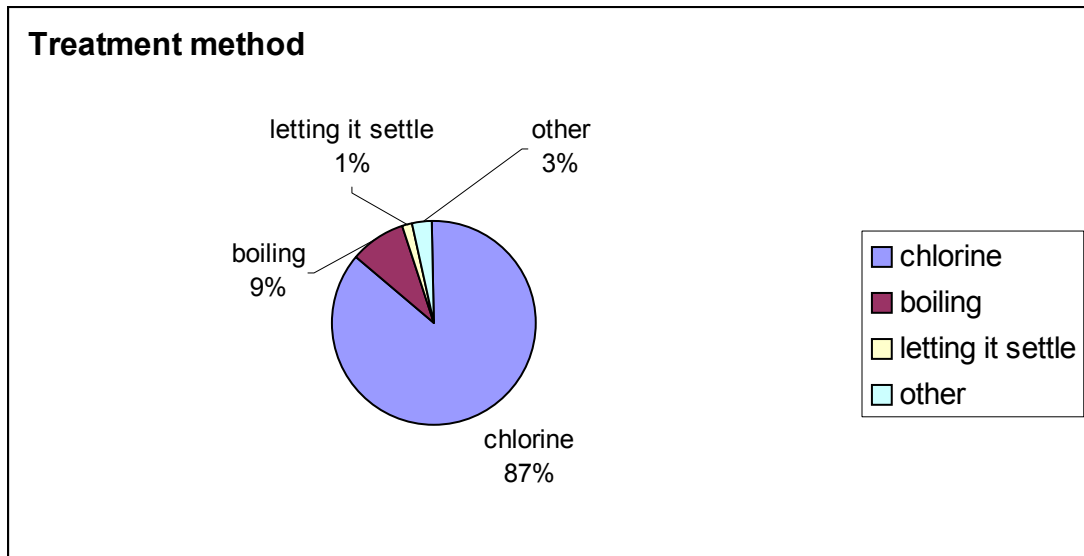


Chart 2. Household treatment of drinking water among those who reported household drinking water treatment in final survey

5.4. Handwashing

Undoubtedly, the best way to record household behaviors is by extended observation. For example, watching behaviors of interest as they occur in a household's normal daily routine is the gold standard. Unfortunately, this methodology is labor and resource intensive. Self-reporting of behaviors and observation of prompted behaviors such as handwashing may overestimate the desired behavior as interviewees may report and demonstrate behaviors they consider to be favorable or ideal (Hawthorn effect). Although these are practical surrogate measures, they may be better indicators of knowledge than of actual behavior.

5.4.1. Handwashing behavior of primary caregiver

The primary adult caregivers of children under five were asked when they wash their hands. Interviewees were not prompted. All responses corresponding to one of the five critical handwashing moments were noted (i.e., each interviewee could have

multiple responses). Four of the responses (e.g., before food preparation, before eating, after cleaning child and before child feeding) failed to demonstrate a statistically different change from the baseline to the later surveys. However, “handwashing before eating” improved significantly (15%), and a (borderline) statistically significant (8%) increase occurred in handwashing “after going to the bathroom” between baseline and final survey.

Table 5. Reported handwashing behaviors for primary caregiver

	Dec-01		May-02		Jun-03		Mar-04		P-value
	N=109		N=125		N=126		N=126		
Critical moments	#	%	#	%	#	%	#	%	Dec-01 to May-02
<i>After going to bathroom</i>	59	54	83	66	75	60	78	62	0.06
<i>Before food preparation</i>	52	48	59	47	65	52	56	44	0.94
<i>Before eating</i>	36	33	44	35	61	48	60	48	0.72
<i>After cleaning child (following defecation)</i>	15	14	21	17	23	18	11	9	0.52
<i>Before child feeding</i>	13	12	15	12	20	16	15	12	0.98

5.4.2. Handwashing of youngest child

Interviewees were also asked about when they wash the hands of the youngest child in the house. Again, there was no prompting. Reporting for handwashing after going to the bathroom nearly doubled, increasing from 15% to 27% by final survey. Likewise, handwashing for the youngest child before eating improved from 33% to 49%. Both these categories showed a slight deterioration over time in comparison to the first midterm survey, but the final survey data is equivalent to data reported in the second midterm. This is, perhaps, an indication of a leveling off of the behavior change with significant improvement over baseline.

Reported handwashing during bathing declined on surveys following the baseline. This may indicate a change in the way caregivers perceive handwashing. For example, before handwashing was promoted in the community, it may have been considered an adjunct to bathing. After visits from the Community Hygiene Promoter, it may have been perceived as a distinctly separate activity. Finally, there was no detectable difference in handwashing before breastfeeding due to the low number of reported cases.

Table 6. Reported handwashing of youngest child

	Dec-01		May-02		Jun-03		Mar-04		P-value
	N=109		N=125		N=126		N=126		
Critical moments	#	%	#	%	#	%	#	%	Dec-01 to May-02
<i>After going to bathroom</i>	16	15	39	31	35	28	34	27	0.003
<i>Before eating</i>	36	33	69	55	62	49	62	49	0.0007
<i>When bathing</i>	39	36	34	27	40	32	28	22	0.15
<i>Before breastfeeding</i>	4	4	2	2	11	9	2	2	0.32

5.4.3. Handwashing technique and facilities

Handwashing facilities

Survey respondents were asked if they would demonstrate how they wash their hands. At baseline 95% and in the later surveys approximately 90% of respondents agreed to demonstrate. Community Hygiene Promoters have encouraged the creation of a permanent, designated handwashing location. It is assumed that people are more likely to wash their hands if they have such a location. Between December 2001 and March 2004, a significant increase (from 17% to 37%) occurred in permanent handwashing facilities. The increase also appears to be fairly steady when comparing to midterm surveys. There was also a decline in “improvised” handwashing facilities between baseline and final survey, but it was not steady across all surveys (Table 7).

Table 7. Characteristics of handwashing facilities

	Dec-01		May-02		Jun-03		Mar-04		P-value
	N=104		N=109		N=103		N=104		
Location	#	%	#	%	#	%	#	%	Dec-01 to May-02
<i>Improvised</i>	67	64	38	35	67	65	53	51	0.0001
<i>Permanent</i>	18	17	33	30	29	28	38	37	0.027
<i>Table</i>	1	1	11	10	1	1	2	2	0.005
<i>Floor</i>	3	3	5	5	4	4	5	5	0.72
<i>Other</i>	3	3	0	0	2	2	6	6	0.11
<i>Unknown</i>	12	12	22	20	0	0	0	0	

Presence and use of soap

Also of importance for effective reduction of micro-organisms when handwashing is the use of soap. A subsidy program was initiated as part of the project to stimulate use

of hand soap to help people adopt this behavior. This subsidy ended shortly after the first mid-term survey.

At baseline, 40% of households did not have soap visible in the area that was reportedly designated for handwashing. At the final survey, there was a 9% improvement with 31% of households without visible soap in the designated handwashing area. In the midterm surveys, the number was even lower at 22% and 21%, respectively (see Table 8). Interestingly, the percent of households with body soap increased from 15% at baseline to 35% at first midterm and reached 51% at second midterm, only to drop down to the baseline level for the final survey. The reverse trend was true for detergent. At baseline, detergent was evident at 29% of designated handwashing locations but dropped to 14% at first midterm and 1% at second midterm, only to increase to 37% in the final survey. However, The high proportion of households with missing data (characterized as “unknowns”) ranging from 14% at baseline to 27% at the first midterm makes it difficult to determine trends with any degree of certainty.

Table 8. Presence and use of soap

	Dec-01		May-02		Jun-03		Mar-04		P-value
	N=109		N=125		N=126		N=126		
Presence of soap (observed)	#	%	#	%	#	%	#	%	Dec-01 to May-02
<i>Detergent</i>	32	29	17	14	1	1	46	37	0.003
<i>Soap</i>	16	15	44	35	64	51	18	14	0.0003
<i>Other</i>	2	2	2	2	9	7	1	1	0.89
<i>None</i>	44	40	28	22	26	21	39	31	0.003
<i>Unknown</i>	15	14	34	27	26	21	22	17	
Use of soap (observed)	N=104		N=109		N=101		N=110		
<i>Yes</i>	61	59	86	75	82	81	76	69	0.009
<i>No</i>	44	42	29	27	19	19	34	31	
<i>Unknown</i>	4	4	10	9	25	25	16	15	

The *observed use* of soap did increase by 10% from baseline to final survey, however, the trend starting in the midterm surveys was higher (see Table 8). One possible explanation for the apparent discrepancy in presence of soap and use of soap while washing their hands is that although it was not visible to the interviewer, the respondent may have had soap stored somewhere and located it for the handwashing demonstration. It is suspected, however, that households with soap visible in the area used for handwashing are more likely to use soap when they are not under observation.

Handwashing technique

Interviewers documented the thoroughness of the primary caregiver’s handwashing behavior by observing how many times they rubbed their hands together. Of those who demonstrated handwashing, there was an improvement of 49% to 72% (combined total of those rubbing their hands three or more times) in handwashing technique in the first midterm compared to baseline only to fall back to baseline levels by the final survey (see Table 9). Perhaps this is an indication of banking on a trend too early where additional reinforcement would have produced more sustainable, positive results. Also, the final survey is the only one where a “no response” was recorded (11%), which may have skewed results.

Table 9. Observed handwashing technique

	Dec-01		May-02		Jun-03		Mar-04		P-value
	N=104		N=117		N=112		N=126		
Handwashing technique	#	%	#	%	#	%	#	%	Dec-01 to May-02
<i>Rub hands together once</i>	8	8	2	2	19	17	18	14	0.05
<i>....twice</i>	41	39	28	24	39	35	34	27	0.03
<i>....three times</i>	35	34	64	55	34	30	40	32	0.0002
<i>....more than three times</i>	16	15	20	17	19	17	14	11	0.56
<i>Did not rub hands together</i>	4	4	3	3	1	1	6	5	0.65
<i>No response</i>		0		0		0	14	11	

5.4.4. Hand-drying technique

Use of a hygienic hand-drying method was promoted as part of the project to reduce recontamination. Hand-drying behaviors significantly improved over the study period. The observed use of a towel increased from 13% at baseline to 48% at final. Air drying also became a dominant technique improving from 6% at baseline to 26% for final survey. Use of clothing to dry one’s hands, the preferred method for hand-drying at baseline, fell to negligible levels by the final survey.

Table 10. Observed method of hand-drying

	Dec-01		May-02		Jun-03		Mar-04		P-value
	N=104		N=115		N=102		N=102		
Method	#	%	#	%	#	%	#	%	Dec-01 to May-02
<i>Towel</i>	14	13	35	30	49	48	49	48	0.003
<i>Other cloth</i>	1	1	24	21	21	21	23	23	<0.0001
<i>Air dry</i>	6	6	44	38	27	26	27	26	<0.0001
<i>Clothes</i>	50	48	6	5	5	5	2	2	<0.0001
<i>Other</i>	0	0	3	3		0	1	1	
<i>Unknown</i>	33	32	3	3	0	0	0	0	

5.5. Excreta Disposal

Sanitation coverage was near universal at baseline as 94% of households reported having a toilet with septic tank, a pit latrine or an elevated-composting latrine (see Table 11). When households with latrines (92 – VIP and composting) were asked how long they have had access to their current facilities in the first midterm survey, the median reported time was 120 days (not shown). In other words, 50% of the survey respondents with latrines had new (less than three month old) facilities. Four percent of the baseline households reported using an open field for defecation, with this number falling to zero for all subsequent surveys.

Table 11. Excreta disposal

	Dec-01		May-02		Jun-03		Mar-04	
	N=109		N=125		N=124		N=126	
Method	#	%	#	%	#	%	#	%
<i>Toilet w/septic tank</i>	11	10	4	3	3	2	1	1
<i>VIP latrine</i>	82	75	80	64	84	68	94	75
<i>2 vault composting latrine</i>	10	9	28	22	35	28	29	23
<i>Open field</i>	4	4	0	0	0	0	0	0
<i>Other/unknown</i>	2	2	13	10	2	2	2	2

5.5.1. Excreta Disposal for children

Interviewees were also asked about excreta disposal for children that were not using the latrine. However, interpretation of data for the disposal of excreta for children using diapers is complicated by high number of “Other” indicated in first and second midterm surveys, 31% and 38% respectively. The sample size for the final survey is

too small to be meaningful compared to results from other surveys. For the disposal of excreta for children using potties, the trend was clearer. While it started out high at the baseline (90%), it showed continuous improvement to 100% by final survey.

Table 12. Disposal of excreta for children using diapers and potties

	Dec-01		May-02		Jun-03		Mar-04		P-value
	N=18		N=32		N=21		N=3		
Disposal of excreta for children using diapers	#	%	#	%	#	%	#	%	Dec-01 to May-02
<i>Latrine</i>	5	28	6	19	5	24	2	67	0.49
<i>Hole in ground</i>	1	6	2	6	4	19		0	1.0
<i>Open field</i>	7	39	6	19	4	19		0	0.18
<i>Rinsed out w/water</i>	5	28	8	25		0	1	33	0.75
<i>Other</i>	0	0	10	31	8	38		0	
Disposal of excreta for children using potties	N=49		N=58		N=38		N=12		
<i>Latrine</i>	44	90	53	91	36	95	12	100	1.0
<i>Hole in ground</i>	2	4	2	3	1	3	0	0	1.0
<i>Open field</i>	1	2	2	3	1	3	0	0	1.0
<i>Other</i>	2	4	1	2		0		0	

5.6. Sanitation Hygiene

Cleanliness of sanitation facilities is associated with use. Interviewers asked permission to look at each household's sanitation facility. They observed the presence of flies and recorded conspicuous odors in close vicinity to the sanitation facilities. Between baseline and final survey, a significant and sustained decrease was noted in relation to the presence of flies (from 19% to 2%) (see Table 13). A decrease (from 11% to 2%) was noted for conspicuous odors. Presence of feces on door and walls decreased from 11% to 0% and feces on seat from 17% to 3%.

Table 13. Sanitation hygiene

	Dec-01		May-02		Jun-03		Mar-04		P-value
	N=109		N=125		N=124		N=126		
Latrine aspect	#	%	#	%	#	%	#	%	Dec-01 to May-02
<i>Presence of flies</i>	21	19	10	8	6	5	3	2	0.01
<i>Bad odors</i>	12	11	9	7	4	3	3	2	0.32
<i>Used for storage</i>	21	19	0	0	1	1	6	5	<0.0001
<i>Feces on floor</i>	4	4	3	2	7	6	1	1	0.71
<i>Feces on seat</i>	19	17	21	17	10	8	4	3	0.92
<i>Feces on door or walls</i>	12	11	2	2	3	2	0	0	0.004

Use of sanitation facilities for storage is believed to be associated with non-use for feces disposal. At the first mid-term, no sanitation facilities were being used for storage, a highly significant decrease. A counterintuitive resurgence in use of the latrine for storage noted in the final survey may be linked to the perception of the now clean and odor free latrine as a more attractive storage location.

Considered to be of importance to the implementing NGOs was increasing use of toilet paper. This practice was incorporated as one of the micro-behaviors that was promoted. Toilet paper use did increase by 12% from baseline to May 2002, with a return toward baseline in the final survey. This may be a function of severe economic instability rather than unsustainability of the change. Toilet paper in real terms for the Dominican consumer is twice the cost it was in 2002 (see Table 14).

Table 14. Self-cleaning after defecation

	Dec-01		May-02		Jun-03		Mar-04		P-value
	N=109		N=125		N=84		N=29		
Material	#	%	#	%	#	%	#	%	Dec-01 to May-02
<i>Toilet paper</i>	85	78	113	90	74	88	24	83	0.20
<i>Notebook paper</i>	7	6	2	2	4	5	4	14	0.09
<i>Newsprint</i>	8	7	3	2	3	4	0	0	0.12
<i>Leaves</i>	2	2	2	2	3	4	0	0	1.0
<i>Water</i>	2	2	0	0		0	0	0	0.22
<i>Other</i>	5	5	5	4	0	0	1	3	

5.7. Hygiene Training of Children

Also of importance is reported hygiene training of children under five years of age by the primary caregiver. Interviewees were asked what they have taught their children about latrine use. Significant initial increases were recorded for reported teaching of self-cleaning from 17% to 27% and how to sit from 16% to 32% in the first midterm survey. Most striking was reported teaching about handwashing after latrine use by 36% of the interviewees at the first mid-term compared to none at baseline. However, these early initial changes eroded significantly by the final survey with only handwashing after use retaining some of the positive gain from baseline data. These changes do appear to need reinforcement if they are to be sustained over time (see Table 15).

Table 15. Teaching children about sanitation use

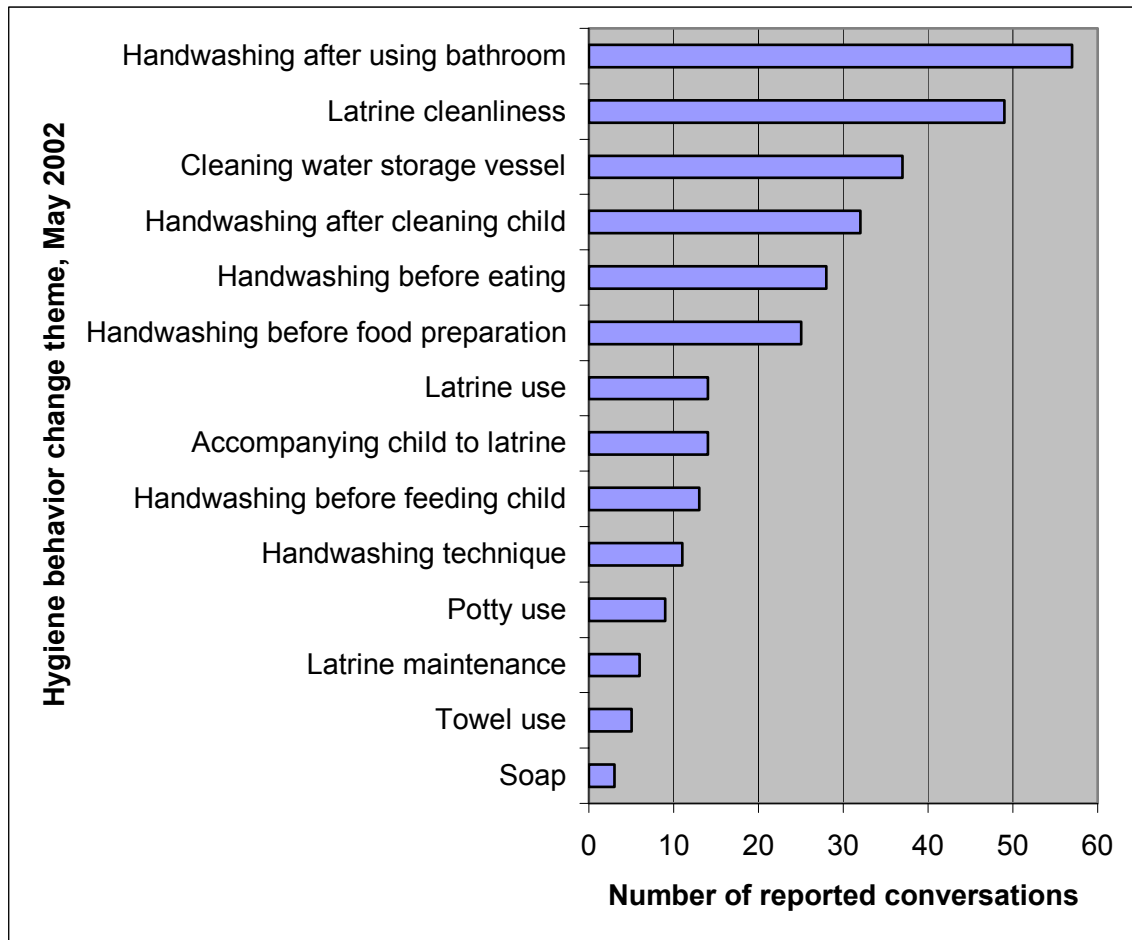
	Dec-01		May-02		Jun-03		Mar-04		P-value
	N=109		N=125		N=124		N=126		
Knowledge/skill	#	%	#	%	#	%	#	%	Dec-01 to May-02
<i>Self-cleaning</i>	18	17	34	27	22	18	7	6	0.046
<i>How to sit</i>	17	16	40	32	13	10	6	5	0.003
<i>Disposal of paper in trash can</i>	8	7	13	10	0	0	1	1	0.40
<i>Close the door</i>	3	3	5	4	1	1	0	0	0.73
<i>Not to go alone</i>	3	3	3	2	2	2	0	0	1.0
<i>Wash hands after use</i>	0	0	45	36	16	13	13	10	<0.0001
<i>Other</i>	6	6	3	2	2	2		0	

5.8. Community Hygiene Promoters

Questions relating directly to the home visits being carried out by the Community Hygiene Promoters were incorporated into the first midterm and following surveys. The first midterm survey showed promising results with 78% of survey respondents reporting that they had been visited by a Community Hygiene Promoter. At the final survey this number was 72%. Interviewees were asked how many times they were visited. In the first midterm survey, the question pertained to a period of five months (since the baseline) and the average number was about three visits per household. The same question was posed in the final survey, however, the results are not comparable as they covered a different time period.

During the project period in 2002, the volunteer Community Hygiene Promoters were encouraged by the collaborating NGOs to visit each home in their area two times monthly. After the project period (from 2003 onward), the promoters were asked to check-in with each home once per month. During focus group meetings with the promoters during the final survey, most were frank in saying that it was not possible to maintain that level of interaction.

Of those reporting a visit, interviewees asked what they talked about during the visit. Responses were non-prompted, and all answers were recorded. Graph 2 below illustrates responses from the highest frequency to the lowest from the first midterm survey. Handwashing after using the bathroom, latrine cleanliness and cleaning of the water storage vessel were recalled most frequently. For the final survey, the order was largely the same, but frequency dropped by approximately 60%. This correlates with a lesser number of visits in the period leading up to the final survey.



Graph 2. Reported conversations with Community Hygiene Promoters at first mid-term survey.

Seventy-four percent of the survey respondents stated that they would like to continue being visited by the Community Hygiene Promoter at midterm, and 93% in the final survey.

5.9. Payment for Services

Although not included as part of the behavior change intervention, the Dominican National Rural Water Authority and NGOs were interested in knowing about household payment of the water quota to the Water Committees. This system is part of the Total Community Participation methodology to improve the potential for sustainability of the project by supplying the Water Committees with funds to repair eventual breakdowns in their system. This shows a willingness to pay for services — an important component of the “enabling environment” defined in the Hygiene Improvement Framework. A significant jump occurred between baseline and subsequent surveys in payment of the water quota as reported by households, 34% at baseline and 96% at final survey. However, a validation check with the treasurers and presidents of the community water associations, during the final survey, indicates that the reported numbers may be fairly optimistic: the association officers made estimates of payment levels that varied between 50% and 80%. The majority (for all surveys) who reported paying also reported that they paid on a monthly basis.

Table 16. Payment for water services and frequency of payment

	Dec-01		May-02		Jun-03		Mar-04	
	N=109		N=125		N=100		N=106	
Paying for water service	#	%	#	%	#	%	#	%
<i>Yes</i>	37	34	103	83	78	78	96	91
<i>No</i>	39	36	9	7	21	21	10	9
<i>Unknown</i>	33	30	13	10	1	1	0	0
Frequency of payment	N=37		N=103		N=92		N=96	
<i>Weekly</i>	0	0	2	2	3	3	1	1
<i>Monthly</i>	36	97	96	93	84	91	90	94
<i>Quarterly</i>	0	0	1	1	3	3	3	3
<i>Unknown</i>	1	3	4	4	2	2	2	2

6. Summary of Findings

1. The results from the baseline to final survey suggest decreases in diarrhea prevalence, with the most dramatic decreases occurring among children from one to three years of age. The overall decrease in diarrhea prevalence from 27% to 11% (P-value=0.0001) over the five month initial study period and its sustainability to the final survey at 13% is impressive. Because sanitation coverage was near universal at baseline (94%), the decrease in diarrhea prevalence is suggestive of the combined effect of the water and hygiene promotion interventions. Seasonal fluctuations in diarrhea rate are an unlikely explanation of this change, although this possibility cannot be ruled out.
2. The sustainability of individual behaviors contributing to the decrease in diarrhea prevalence are highly variable, with some behaviors rapidly returning to baseline levels as promotion activities are withdrawn, while others show signs of “taking root.”
3. Improvements (from 54% to 62%) in reported handwashing after going to the bathroom may correspond to the most frequently cited conversations with Hygiene Promoters on this same theme. Showing the most significant improvement in handwashing was handwashing before eating which rose 15% and which was also the subject of frequent promoter conversations. Likewise, reported handwashing for the youngest child after going to the bathroom and before eating significantly increased. Again, this may be associated with the work of the Hygiene Promoters. For other handwashing behaviors (e.g., before food preparation, after cleaning child (following defecation), and before child feeding), there is an indication that improvements need reinforcement to be sustained over time.
4. Improvements of hand-drying behaviors were significant, especially in light of the relatively low frequency of cited conversations with Hygiene Promoters on towel use. This seems to indicate that this behavior can be significantly and sustainably changed with limited reinforcement. The primary practice at baseline, use of clothing to dry one’s hands, fell to negligible levels by the final survey. The observed use of a towel increased from 13% to 48%, and air drying also became a dominant technique improving from 6% to 26%.
5. While there was a large initial increase in caregiver reported teaching of appropriate and hygienic use of sanitation facilities to children, it declined by the final survey to well below baseline levels. Reported teaching of self-cleaning went from 17% at baseline to a high of 27% at first mid-term, then falling to 6% by the final survey, with teaching of how to sit in the latrine following a similar

pattern. Teaching to put the toilet paper in the can showed an even more steep decline, falling to just 1% at the final after going from 7% at baseline to a high of 10% at midterm. Teaching handwashing was different from the other behaviors in that it was a behavior that was reportedly not being taught at all (0%) prior to the project intervention. Though there was a steep decline from 36% to 10% after the midterm, the final survey level was still appreciably higher than baseline. Correctly interpreting these data sets may require a different point of reference than others in the survey. The other behaviors studied are “action behaviors” where this is a case of a “teaching behavior” to a third party. It is possible that the falloff after the midterm high point is due the desired behavior being assimilated on the part of this cohort of children—that is, a fall to below baseline in the teaching actions could well be a success indicator rather than the opposite.

6. Latrine cleanliness was the second most cited topic of conversation with the CHP. This may correspond to a decrease in the observed presence of flies, perceived odor in the vicinity of the sanitation facilities, observed feces on the walls and door, and seat of the facilities. Though initial December 2001 to May 2002 results showed only limited statistical significance, the June 2003 and March 2004 surveys show a clear pattern of continued improvement, even with a reduction of hygiene promotion.
7. It appears as if the micro-credit program to stimulate the use of soap may have only succeeded in replacing detergent with hand soap in the first midterm survey, instead of increasing the overall presence of body soap. This trend reverted to baseline by the final survey. The apparent discrepancy between presence of soap and use of soap may be attributable to the fact that interviewers first recorded visible soap in the area used for handwashing. Many respondents may have located soap, which was initially not visible to the interviewer once they agreed to demonstrate washing their hands — one such respondent had soap stored under her bed.
8. Another important finding is that permanent handwashing areas have increased from 17% to 37%. A permanent place to wash one’s hands may facilitate the transformation of new handwashing behaviors into habits. However, a long period of coaching may be necessary to make the “permanent” handwashing area truly permanent

Overall, these findings are suggestive of the effect of the hygiene behavior change intervention. While not universal, several positive changes in hygiene related behaviors and outcomes have been documented. Additional qualitative research may help to explain why increases occurred in reported handwashing before eating and after going to the bathroom, yet no reported changes for handwashing at other critical moments.

7. Conclusions

1. This study was highly successful in mobilizing a diverse inter-institutional team to carry out the many and varied tasks necessary to complete four field surveys. Active participation from all stakeholders undoubtedly increased ownership of the project and interest in the results. However, the decentralized management of the study resulted in compromises to the study design that limit the analysis and therefore utility of the findings beyond the households included in the sample.
2. One recommendation for future projects would be to evaluate the effectiveness and sustainability of the hygiene behavior change program conducted in the DR and to compare the approach to other hygiene promotion efforts in a more rigorous external evaluation. Such an evaluation would be useful for advocating hygiene behavior change interventions in the DR and elsewhere.
3. If possible, future evaluation research should try to look at the effects of hygiene behavior change interventions separately from other child health interventions. Isolating the effects of hygiene, water and sanitation can help the interpretation of the joint or synergistic interaction of integrated programs. This could be accomplished by selecting communities with similar characteristics and focusing on specific hygiene behaviors in each one, along with a control community in which no additional hygiene behavior change promotion occurs. Separating out hygiene promotion will also make it possible to measure costs separately from other interventions. This would enable an analysis of the cost effectiveness of hygiene promotion — the monetary value per unit of health effect (e.g., \$/diarrhea case averted). Cost-effectiveness analysis can be a powerful advocacy tool that can help stakeholders make informed decisions for effective, results oriented allocation of resources. However, the rigor and resources required for this type of study is beyond the capability of most NGOs and should be conducted by a research institution.
4. The resources and effort involved in community level data collection in participatory monitoring cannot be underestimated. A survey requires a great deal of coordination and personnel from the NGOs and is often viewed as an “extra” activity that must be fit in along with their other activities. It is critical that the program extract the maximum value from the data collected. More complex statistical analysis could shed light on significant associations between key behaviors and health outcomes. This kind of information is invaluable for program managers and health promoters alike to better understand where to focus their efforts. However, due to the limitations associated with participatory monitoring, such an analysis should be deferred to a more rigorous cost-effectiveness analysis mentioned above.

5. The participatory monitoring in the nine pilot communities has provided some important insights and valuable lessons learned for future evaluation research for hygiene behavior change interventions:
 - a. Participatory monitoring is a useful approach for program managers and communities when it accompanies a behavior change programming process.
 - b. Participatory monitoring provides useful and timely information because it is built into the program, but it also has clear methodological limitations related to scientific rigor and generalizability beyond the population included in the survey.
6. The behavior change methodology employed in the Hato Mayor pilot seems to have been proven effective within the sample population. The pilot activity was an essential first step in demonstrating the effectiveness of the methodology.
7. Implementation of the behavior change methodology at a larger scale (scale-up) is the next logical step. Successful implementation on a broader scale is dependent on an effective methodology that is feasible, practical and affordable for implementation by NGOs (with less reliance on external technical assistance and funding). The pilot provided some insights on some necessary aspects for larger scale implementation. These insights provided the basis for the design of hygiene behavior change activities conducted over the past year, coordinated by the NGO, ALIANZA.
 - Support from funding agencies — The connection between diarrhea prevention (improved health) and hygiene behavior change is a critical case to make with potential funding agencies to attract financial support as NGOs are typically dependent on funding agencies to provide the financial support necessary to carry out their programs.
 - Conducive policies and environment — The strong advocacy role played by USAID/DR, PAHO and others along with the INAPA policy of including hygiene promotion as a component of every water and sanitation project provide a good example of an “enabling environment,” supportive of the hygiene behavior change approach for hygiene promotion.
 - Local expertise — A critical mass of local expertise in implementation of the methodology: ALIANZA has conducted a series of hygiene behavior change training activities to develop local capacity of a number of NGOs from different regions in the DR.
 - Technical/materials resource — Notwithstanding the existence of geographically dispersed local expertise, the presence and availability of a technical resource in hygiene behavior change, monitoring/evaluation and

promotional materials provides a support mechanism for information sharing between individual NGO activities in hygiene behavior change as well as providing the benefit of experience gained in programs outside the DR. ALIANZA has served as coordinator for HBC activities in the DR, has developed internal technical expertise, established a website for information sharing, and is disseminating promotional materials.

The pilot was designed to build local capacity to implement behavior change activities and to monitor and evaluate them to create a base level of knowledge and experience for implementation at a larger scale. The activities conducted over the last year in the Dominican Republic, not specifically associated with the Hato Mayor pilot, were undertaken with the intent to broaden the local knowledge and experience base to enhance the possibility for successful implementation at a larger scale. These activities will be described in a pending EHP Summary Activity Report. The report will provide additional detail on training activities, organizations receiving training and where they plan to implement behavior change activities. While these initial building blocks for success are in place, it is too early to generalize the findings. This would be an ideal opportunity for a future study on the scalability of the approach.

References

- Alam *et al.* cited in Burger S *et al.*, 1995
- Baker A.B. and C.A. Brownson .1999. "Chapter 2: Defining characteristics of community-based health promotion programs." In: *Community-Based Prevention. Programs that work.* Gaithersburg, MD: Aspen Publishers.
- Bhattacharyya K., P. Winch, K. Leban, T. Marie. 2001. *Community Health Worker Incentives and Disincentives: How They Affect Motivation, Retention, and Sustainability.* Arlington, Virginia: Basic Support for Institutionalizing Child Survival Project (BASICS II).
- Billig P, D. Bendahmane, A. Swindale. 1999. *Water and Sanitation Indicators Measurement Guide.* Washington D.C.: Food and Nutrition Technical Assistance Project (FANTA).
- Briscoe J. 1984. "Intervention studies and the definition of dominant transmission routes." *American Journal of Epidemiology*, Vol. 120, No.3:449-455
- Briscoe J. 1984. "Water supply and health in developing countries: selective primary health care revisited." *American Journal of Public Health*, Vol. 74, No. 9:1009-1013
- Curtis V., Cairncross S, 2003. "Effect of Washing Hands with Soap on Diarrhea Risk: A Systematic Review." *Lancet Infectious Disease* 2003, May 3(5):275-81
- Esrey S., J. Potash, L. Roberts, C. Shiff. 1991. "Effects of improved water supply and sanitation on ascariasis, diarrhea, dracunculiasis, hookworm infactions, schistosomiasis, and trachoma," *Bulletin World Health Organization*, 69:609-621
- Burger S, and S. Esrey. 1995. "Water and Sanitation: Health and Nutrition Benefits to Children." In: *Child Growth and Nutrition in Developing Countries: Priorities for Action.* New York: Cornell University Press, 153-174.
- Gordis L. 2000. *Epidemiology.* Philadelphia, Pennsylvania W.B. Saunders Company.
- Haggerty P., M. Kalengaie , B. Kirkwood, A. Ashworth, M. Manunebo. 1994. "Community-based Hygiene Education to Reduce Diarrhoeal Disease in Rural Zaire: Impact of the Intervention on Diarrhoeal Morbidity," *International Journal of Epidemiology*, Vol. 23, No. 5:1050-59
- Han A and T. Hlaing. 1989. "Prevention of diarrhea and dysentery by hand washing," *Transactions of the Royal Society of Tropical Medicine and Hygiene*; 83:128-131

- Hancock T and Minkler M. 1997. "Community health assessment or healthy community assessment. Whose Community? Whose Health? Whose Assessment? Chapter 9 In: Minkler, M, ed., *Community Organizing & Community Building for Health*. New Brunswick, N.J.: Rutgers University Press.
- Huttly S., S. Morris, V. Pisani. 1997. "Prevention of diarrhea in young children in developing countries," *Bulletin World Health Organization*, 75(2):163-174
- Institute of Medicine. 1997. "Measurement Tools for a community health improvement process. Chapter 6," In: *Improving Health in the Community. A Role for Performance Monitoring*. Washington D.C.:National Academy Press.
- Kawata, D. 1978. "Water and other environmental interventions-the minimum investment concept," *American Journal of Clinical Nutrition*, 31:118-126
- Kolsky P. 1993. "Diarrhoeal disease: current concepts and future challenges," *Transactions of the Royal Society of Tropical Medicine and Hygiene*; 87. Supplement 3: 43-46
- Macro International. 1999. *Experimental Demographic and Health Survey, Dominican Republic; Santo Domingo, Dominican Republic*. Maryland: Macro International.
- Minkler M and N. Wallerstein. 1997. "Improving health through community organization and community building, chapter 12," In: Glanz D., F.M. Lewis and B.K. Rimer, eds., *Health Behavior and Health Education: Theory, Research and Practice*. San Francisco, CA: Jossey-Bass Publishers.
- Okun D. 1988. "The value of water supply and sanitation in development: an assessment," *American Journal of Public Health* Vol. 78, No. 11:1463-67
- Pan American Health Organization. 2000. *Evaluación de los Servicios de Agua Potable y Saneamiento en las Americas. Santo Domingo, Dominican Republic*. Washington D.C.: Pan American Health Organization.
- Pan American Health Organization. 2001. *Special Program for Health Analysis and Program on Communicable Diseases*. Washington D.C.: Pan American Health Organization. <http://www.paho.org/English/HCP/HCT/IMCI/graficas.ppt> - Retrieved March 30, 2003.
- Sarriot E. 2002. *The Child Survival Sustainability Assessment: For a Shared Sustainability Evaluation Methodology in Child Survival Interventions*. Calverton, Maryland: Child Survival Technical Support project and the Child Survival Collaborations and Resources Group (CORE).
- Shuval H., R. Tilden, B. Perry, R. Grosse. 1981. "Effect of investments in water supply and sanitation on health status: a threshold-saturation theory," *Bulletin World Health Organization*, 59(2)243-48

- Torres, M.P., D. Bendahmane, M. Post, E. Kleinau. 2004. *Combining Hygiene Behavior Change with Water & Sanitation: A Pilot Project in Hato Mayor, Dominican Republic, April 2000 – May 2002*. EHP Activity Report 125. Arlington, VA: Environmental Health Project.
- Hato Mayor, Dominican Republic Shuval H., R. Tilden, B. Perry, R. Grosse. 1981. "Effect of investments in water supply and sanitation on health status: a threshold-saturation theory," *Bulletin World Health Organization*, 59(2):243-48
- Varley R. 1996. *Child Survival and Environmental Health Interventions: A Cost-Effectiveness Analysis*. EHP Applied Study No. 4. Arlington, VA: Environmental Health Project.
- Varley R., J. Tarvid, D. Chao. 1998. "A reassessment of the cost-effectiveness of water and sanitation interventions in programmes for controlling childhood diarrhea," *Bulletin World Health Organization*, 76(6):617-631
- Werner D. 1988. "Empowerment and Health," *Contact*, No. 102. Geneva: Christian Medical Commission.
- World Health Organization. 1998. *Health Promotion Glossary*. Geneva: World Health Organization.
- World Health Organization. 2003. *World Health Report 2003: Shaping the Future*. Geneva: World Health Organization.
- World Bank. 1992. *Human Development Network, Development Data Group, HNP Stats, Latin America and the Caribbean Deaths*. Washington D.C.: World Bank. <http://devdata.worldbank.org/hnpstats/> - retrieved February 23, 200

