

Adoption of Safe Water Behaviors in Zambia: Comparing Educational and Motivational Approaches

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ABSTRACT

Context: In the developing world, drinking water is an important route for transmission of diarrheal disease, a leading cause of morbidity and mortality in children.

Objectives: In Field Trial I (FTI) and Field Trial 2 (FT2), the effectiveness of the behavior change approach known as motivational interviewing (MI) was compared to the standard practice of health education alone in initiating and sustaining safe water treatment and storage behavior among community residents. In Field Trial 3 (FT3), MI was compared with social marketing.

Design: Community surveys were conducted prior to local health promoter training and at follow-up.

Setting and Participants: Low socioeconomic status peri-urban communities in Zambia were project sites. Local volunteer health promoters from communities were trained in an adaptation of MI for safe water treatment and storage.

Interventions: All health promoters received instruction in the causes and prevention of diarrhea. Health promoters in the experimental (MI) groups received MI training.

Main Outcome Measures: FT1 and FT3 measured detectable disinfectant levels in stored household water. FT2 measured disinfectant sales.

Findings: No significant differences between the treatment groups were found in FT1. Subsequent MI training incorporated lessons learned from the previous trial and resulted in much higher purchase rates of the disinfectant (FT2) and levels of disinfectant in stored household water (FT3) in the MI group.

Conclusion: MI appears promising for public health initiatives in the developing world. Further research to improve and refine the method is needed.

KEYWORDS: Behavior change, motivational interviewing, health promotion, water purification.

CONTEXT

In the developing world, diarrhea is a leading cause of morbidity and mortality in children younger than five years old (Bern et al., 1992). Drinking water is an important route of disease transmission in many countries where there is no infrastructure for managing human waste or for insuring safe water through treatment (Tauxe et al., 1995). This problem affects more than a billion people, particularly the economically disadvantaged (Centers for Disease Control, 1990). The Centers for Disease Control (CDC) and the Pan American Health Organization responded to this urgent problem by developing a Safe Water System (SWS) which is a simple, inexpensive, easily disseminated, and effective intervention for safe water treatment and storage at the household level.

The SWS involves three complementary elements: point-of-use water disinfection with a locally produced sodium hypochlorite solution (chlorine); durable, narrow-mouthed plastic storage vessels with a lid and spigot; and community education

(Mintz & Tauxe, 1995). Field trials in Latin America have demonstrated that the SWS has improved domestic water quality and reduced diarrheal disease incidence by 40% or more (Quick et al., 1996, 1999).

Diarrheal diseases, along with many other illnesses burgeoning in the developing world, have strong behavioral components. It follows, then, that behavioral interventions would hold promise in reducing their incidence and improving public health. One example is motivational interviewing (MI), which is grounded in decision-making theory and motivational psychology (Miller & Rollnick, 1991). MI incorporates the transtheoretical model of the stages of change (Prochaska & DiClemente, 1984, 1992). This model conceptualizes change as a process. People move through stages towards behavior change with corresponding different levels of readiness from precontemplation (where there is no awareness for any need to change), through contemplation, preparation, action, and maintenance (where behavior change has been sustained for at least six months). Stage-based interventions which employ special strategies for different stages have successfully promoted healthy behavior change (Perz et al., 1996; Prochaska & Velicer, 1997). This conceptualization assumes that it is not appropriate or effective to give advice for taking action to a person who is not ready for change. The MI approach seeks to resolve ambivalence through communication techniques consonant with the stage of change model. An empathic style is used to facilitate a person's own decision to choose a change in behavior.

MI has been developed and empirically supported in health behavior change, particularly in alcohol and other drug abuse and dependence (Bien et al., 1993; Miller et al., 1993; Saunders et al., 1995; Daley et al., 1998; Project MATCH Research Group, 1997, 1998) and diabetes control (Smith et al., 1997). However, all studies and clinical applications have taken place in developed countries where human and financial resources are abundant. Its potential for the rest of the world is untested. Because MI is person-centered, culturally competent, and effective in producing healthy lifestyle behavior change, it was a promising approach to implement in the present studies.

OBJECTIVES

The studies reported here describe the first application of MI principles in the developing world, with health workers directly from communities in Zambia. Of interest was whether a derivative of MI would be more efficacious than standard health education to stimulate the initiation and maintenance of safe water treatment and storage behaviors using the Safe Water System (SWS). In Field Trial 1 (FT1) and Field Trial 2 (FT2), standard health education was compared with MI. In Field Trial 3 (FT3), the effectiveness of social marketing was compared to MI. Volunteer community health promoters who were members of the local Neighborhood Health Committees (NHCs) provided the interventions.

DESIGN

Focus groups and individual interviews with community residents were under-taken to gain an understanding of the community's health beliefs. Baseline surveys to determine demographic information, water handling and sanitary practices, and beliefs about the causes, treatment, and prevention of diarrhea were also conducted. All NHCs were given instruction in the correct use of the SWS and health education

on the causes and prevention of diarrhea. Only the experimental groups of NHCs received training in MI.

The SWS was then distributed and visits to randomly selected households ensued to deliver the behavioral interventions. For all studies, the length of household meetings ranged from 10 to 25 minutes each. In-field supervision was accomplished with a local nurse (FT2) or social scientists (FT3) who were trained along with the NHCs. The survey was readministered at follow up. The individuals involved in the community surveys did not have information on house assignment to experimental conditions. Data were collected on disinfectant sales and/or presence of disinfectant residuals in household water.

SETTING AND PARTICIPANTS

Four low socioeconomic status peri-urban communities in Zambia were selected as project sites. FT1 occurred from March through June 1998 in Ipusukilo and included 166 households. FT2 took place in Luangwa from June 1988 through January 1999 with 332 participating households. FT3 was conducted in Kawama (198 households) and Chipulukusu (100 households) from July through October 1999. Informed consent in accordance with the requirements of the CDC Institutional Review Board and the Ethics Committee of the Tropical Diseases Research Centre of Zambia was obtained from all study participants.

Five NHCs were assigned to the intervention group (MI) and five others to the comparison group (health education only) for each of the first two field trials. In FT1, households were assigned to experimental condition based on proximity to the NHC's residence. In FT2 and FT3, treatment zones were geographically separate and randomly selected. The MI household assignments in FT3 were also randomly assigned to the NHCs.

FT3 coincided with the beginning of a social marketing campaign around the city of Ndola. Social marketing employs marketing and advertising for promotion of health products in the developing world using principles that have been successful in developed countries. The Kawama community was randomly selected to be the MI experimental community and 18 NHCs from Central zone (100 random households) were trained. Also participating in the training were three social scientists from the Zambia Tropical Diseases Research Centre who helped with community selection, instrument development, training and ongoing data collection. They worked with local leaders. Njanji zone in Kawama (98 random households) and a zone in Chipulukusu community (100 random households) served as comparison areas and received social marketing only.

Table 1 provides data on sample characteristics. To determine estimated household wealth, respondents were asked if the family possessed certain common household items. Local vendors and community members provided typical local prices for each item. Estimated relative household wealth was then calculated by summing the median price of owned items.

Table 1. Demographic characteristics of sample populations, Field Trials 1-3

	FT1	FT2	FT3
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	Ipusukilo ¹	Luangwa ²	Kawama/ Chipulukusu ³
Total N (households)	166	332	298
Persons per household	5.8	6.2	5.8
Median age of respondents	33 (14-89)	28 (10-79)	35.3 (16-77)
% Female respondents	77	72	77
Estimated wealth	Not asked	\$103	\$55
Water source	166 (100%) Shallow well	99 (100%) Shallow well	228 (76%) Communal tap

¹ Entire study population.

² Random sample of the MI and comparison group populations.

³ Entire study population.

Note: no statistically significant differences were found between the intervention and comparison households in any of the three field trials on demographic variables.

INTERVENTION

All NHCs in both the comparison and experimental conditions received health education from a local nurse in the causes and prevention of diarrhea. Education and demonstration in the proper use of the SWS was accomplished by the CDC team (FT1 and FT2) or staff from the social marketing agency, Society for Family Health (FT3). Proper use of the SWS involves treating household water with disinfectant and, to avoid recontamination, storing treated water in an appropriate (closed-lid) container and preventing hands from coming into contact with the water during retrieval. In a family of four, a single bottle of disinfectant lasts for approximately four weeks.

Training in MI evolved over the course of the three trials and was provided by the MI-trained behavioral scientist on the team (AKT) for all three field trials. In FT1, English-speaking local nurses were trained first and separately for 10 hours over four days in two weeks. The nurses then assisted with the NHC training and translated into the local language (Bemba). Training elements included the stages of change model and general stage-based interventions. For example, in the case of a person who is ambivalent (contemplation stage), one would raise doubt and develop discrepancy. The spirit of MI, which involves empathetically joining with people in a partnership role, was emphasized. Direct persuasion is avoided. Exercises from the Miller & Rollnick work (1991) were adapted to water and sanitation behaviors and to local cultural conditions. These exercises covered the tools of MI: open-ended questions, affirmations, reflective listening, and summarizing. Didactic instruction and demonstration from the trainer was coupled with liberal use of role-play.

MI training for FT1 was planned to be delivered in two to three hours per day over five to seven days in two weeks, for a total of 15-21 hours. The actual delivery was far short of this goal due to absenteeism (caused by funerals and illnesses). Only five hours were accomplished in three sessions over two weeks. Much review of basic concepts was needed and little progress or practice was achieved. Furthermore, at the start of the study, basic communication skills were imparted to both the

experimental and the comparison group of NHCs during a two-hour session to review the project design, rationale, and procedures.

FT2 was designed with recognition of the errors and problems encountered in FT1. Luangwa had an excellent health clinic team and a motivated group of NHCs, which contributed to the decision, with a community nurse, to initiate a second study there. Training was concentrated and restricted to the MI group only. The principles of MI, which include expressing empathy, developing discrepancy, avoiding argumentation, rolling with resistance, and supporting self-efficacy (Miller & Rollnick, 1991; Miller *et al.*, 1992), were described in greater detail with corresponding exercises or examples. Training also included recognizing, reflecting, and eliciting change statements. Change statements are those that express recognition of the problem, concern about it, intention to change, or optimism about changing.

Training for FT2 was completed in eight hours over two consecutive days (four hours/day). The nurse-organizer had participated in FT1, making this training her third. Thus, she was more proficient at providing the field supervision and giving remedial instruction. This made quality assurance ratings possible. Each volunteer was monitored by direct observation at least three times during the first three months of the eight-month study and rated for competency in adhering to the components of MI.

For FT3, the training was again intensified, with more focus on summarizing and change statements. The idea of posing a key question when a person appears to have resolved ambivalence was added. All NHCs from one large zone were included. Training was completed in four full days. In field supervision was incorporated following the conclusion of training and a "buddy system" was utilized which coupled stronger MI-skilled NHCs with weaker ones.

MAIN OUTCOME MEASURES

For FT1, stored household water was tested for chlorine residuals four times, approximately two weeks apart over the eight-week trial. Funding limitations restricted the ability to perform water testing in FT2. Rather, monthly sales ratios for the two treatment groups (health education only versus MI) were utilized to measure outcome. This allowed for a much longer evaluation period of eight months. Monitoring of the experimental condition for FT2 was attempted for the salient features of the intervention. In FT3, the main outcome measure was the same as FT1, that is, measurement of chlorine residuals in household stored water as evidence of use of the disinfectant.

FINDINGS

In FT1 there were very high adherence rates and community acceptance of the SWS (range 71.7% to 94.7% over eight weeks). No significant difference was found between the comparison and experimental groups in FT1 (Thevos *et al.*, 2000).

Over the subsequent eight months after the MI intervention in FT2, a significantly greater number of disinfectant bottles were sold to the MI zone households when compared to the comparison households ($t(7) = 10.69$, $p < 0.001$; $\eta^2 = 0.94$). Specifically, households in the MI zone consistently bought between 61% to 77%

(mean 71%) more bottles of chlorine a month than Ed Only zone households (Thevos *et al.*, 2000).

Quality assurance data for FT2 showed stable overall high ratings over time on four items: avoiding argumentation, encouraging a commitment to take steps, expressing empathy, and using the tools of MI (group means range from 4.49 to 4.58 on a 1 to 5 scale, SDs range from 0.49 to 0.88). The lowest overall mean was reflected in the scores rating change statements (4.07); the highest mean resulted from the ratings on expressing empathy (4.58).

FT3 results are presented in Table 2. The percentage of MI households with residuals of water disinfectant in their household stored water increased significantly from 1% at baseline to 65% four months later ($\chi^2(1) = 74.4, p < 0.001$; effect size (Cramer's V) = 0.64, ($p = 0.000$)). Similarly, significant increases in knowledge about diarrhea were also found. In the comparison areas, there were no significant differences between the baseline and follow-up data on these measures.

Table 2. Baseline and follow-up data in MI intervention (Central) zone and comparison (Njanji and Chipulukusu) zones, Field Trial 3 (FT3), July-October 1999

	FT3: Kawama, MI zone ("Central zone"), N = 100		FT3: Kawama, comparison zone ("Njanji zone"), N = 98		FT3: Chipulukusu, comparison zone ("Zone 1"), N = 100	
	Baseline	Follow-up	Baseline	Follow-up	Baseline	Follow-up
Residual disinfectant present in stored household water	1%	65% ¹	2%	4%	34%	16% ²
Ever use disinfectant	13%	99%	18%	34%	9%	18%
Know that contaminated water causes diarrhea	31%	72%	46%	42%	41%	48%
Believe that can avoid diarrhea	83%	91%	78%	92%	80%	88%
Know that can avoid diarrhea by boiling or treating water	61%	96%	47%	62%	41%	53%

¹ $\chi^2(1) = 74.4, p < 0.001$; effect size (Cramer's V) = 0.64, $p = 0.000$.

² Source water is a communal tap that had detectable disinfectant residuals on the day of testing. At follow-up, no household reported that they were using the

disinfectant, none had a disinfectant bottle in their house, and none had detectable residuals in their water.

DISCUSSION

This paper describes lessons learned and the evolution of training methods in MI, a promising method for health promoters to use as a tool to potentiate healthy behavior change. In these studies, the target behavior involved safe water practices.

In FT1, there were consistently high rates of adherence to the SWS, with no differences between the treatment groups. There are several possible explanations for this. Primary among them is the inadequate MI training, compounded by communication skill training being delivered to the comparison group. Another possible factor is that disinfectant was available to all study participants free of charge. Measuring motivation for enduring behavior change can not be achieved under circumstances where participants do not expend effort or resources to engage in the behavior. Finally, the comparison and intervention households were mixed together in the same zones in the community, making discrimination between the conditions less likely due to possible diffusion throughout the zone or a household member's prior personal relationship to an NHC (Rogers, 1995).

For FT2, many of the problems encountered in FT1 were averted. MI training was considerably improved, the study length was extended, and there was no contact by the behavioral scientist in the comparison condition. The results were impressive and were sustained over eight months. The rates of purchase of disinfectant were much higher in the MI zone compared to the health education zone. The outcome measure of disinfectant sales in this trial may be a more sensitive measure of intrinsic behavior change since, in this low socioeconomic group, the choice to disburse precious resources and implement the SWS can be thought to be representative of motivation and real behavior change.

There are serious limitations with regard to the monitoring and rating of the delivery of MI in the field during FT2. The data are only exploratory in nature and require cautious interpretation. The nurse who provided them was not blind to condition and the ratings are liberal. Yet they still render information that can be used to refine future work in this area.

The results of the water testing in FT3 are striking and very encouraging. All indicators of safe water practices and knowledge improved dramatically in the MI zone after the intervention, compared to social marketing alone. However, more study is needed to determine the sustainability of the intervention and the effect of seasonal variation of diarrheal disease and community water quality on use of the SWS.

CONCLUSION

Given the magnitude and devastating human, economic, and social effects of illnesses on large populations in developing countries, novel approaches are needed to help health promoters be more effective in influencing health behaviors. The studies reported here demonstrate the strong potential of MI to enhance public health initiatives in developing countries. Diffusion research stresses the importance of interpersonal communication, as opposed to the exclusive use of mass media, as a

key determinant in the adoption of innovation into widespread use (Rogers, 1995). MI is a method of respectful interpersonal communication about behavior and can be an important adjunct to other health promotion efforts. Training methods, field supervision techniques, and quality assurance methodology remain to be improved and refined for these settings and types of applications. Further study is needed to elucidate MI's potential in helping to reduce morbidity and mortality in the developing world.

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