

The Outcome Evaluation of a CHW Cancer Prevention Intervention: Testing Individual and Multilevel Predictors Among Hispanics Living Along the Texas-Mexico Border

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Abstract This paper evaluates the effectiveness of community health workers/promotores (CHWs) in promoting cancer preventive behaviors in the 2011–2013 Education to Promote Improved Cancer Outcomes (ÉPICO) project. The ÉPICO project utilized CHWs to disseminate cancer education to predominantly Spanish-speaking Hispanics living in colonias in the Lower Rio Grande Valley of Texas. The CHWs received training to become Texas-certified CHW instructors and specialized training in message tailoring, and they delivered more than 5000 units of resident education on cancer prevention/detection, treatment, and survivorship for breast, cervical, and colorectal cancer. Using panel data to examine overtime changes in cancer knowledge among Lower Rio Grande Valley residents, the evaluation found significant changes from baseline to both times 1 and 2. Additional individual-level analysis indicated that the increase in resident cancer knowledge was predicted by residents' perceptions of CHW credibility and intention to change their lifestyles. Multilevel analysis also showed that the increase in cancer prevention knowledge among residents was predicted by attributes of the CHWs who taught them. In particular, CHWs with higher

education levels had the most impact on residents' increased knowledge over time. Unexpectedly, CHWs with more years of experience were less effective teachers than their early-career counterparts.

Keywords Cancer education · Community health workers · Hispanic populations

Introduction

Engaging community health workers (CHWs, also referred to as *promotores*, lay-health workers, community health representatives, and numerous other titles) is an effective strategy to deliver health education messages to at-risk, underserved populations [1]. CHWs represent a vital channel for delivering health education messages to individuals who would otherwise not receive essential information [2], utilizing culturally appropriate techniques to educate, train, and support community members to achieve improved health outcomes. CHWs' respected status within their communities is a key factor in the success of this health promotion model [3].

Though the literature generally documents CHW effectiveness, the specific factors that may explain the success of a given CHW intervention are less understood. As CHWs increasingly engage in health promotion and outreach projects [4], understanding the ways in which CHWs can influence community members' knowledge development is an important and timely need. Researchers have studied the outcomes of individual projects engaging CHWs, but analysis linking CHW characteristics to community health outcomes is scarce [5, 6]. That is to say, scholarship provides evidence that CHWs are effective in reaching vulnerable communities, and community-based interventions utilizing CHWs have been successful in improving health knowledge and outcomes

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[7]. What remains to be explored is whether and how the personal characteristics of CHWs play a role in knowledge change of the target community. Such processes are multilevel in nature, accounting for the individual and relationship levels of the social ecological model [8]. To address this gap in the literature, this paper presents findings from the Education to Promote Improved Cancer Outcomes (ÉPICO) project.

ÉPICO

ÉPICO emerged as a response to existing racial/ethnic health disparities related to cancer education, treatment, survivorship, and outcomes. Cancer is the second leading cause of death among Hispanics in the USA [9], and Hispanics are less likely to participate in cancer prevention strategies (such as screening) [10]. When Hispanics do engage in detection behaviors, they are often diagnosed and treated at later stages of cancer [11]. Moreover, Hispanics face greater cancer survivorship issues than non-Hispanic Whites, such as lower quality of life [12]. Poverty, lack of education and information, lack of health insurance [13], language barriers [14], and low health literacy [15] contribute to poorer cancer outcomes in Hispanics related to prevention, treatment, and survivorship.

In response to the clear need for culturally appropriate education, communication, and outreach strategies to decrease barriers and improve cancer-related survivorship [15], ÉPICO incorporated evidence-based cancer prevention, treatment, and survivorship strategies to help reduce cancer mortality rates [16]. ÉPICO addressed key barriers to improved cancer knowledge and behaviors among Hispanics in South Texas with two evidence-based, culturally appropriate intervention strategies: (1) using CHWs to conduct outreach and education [17] and (2) tailoring messaging for individual audience members [18].

The project team designed ÉPICO to improve cancer outcomes, including cancer-preventive knowledge. Knowledge development is a critical component of the intervention, both for its own sake and also as a precedent for attitudinal and behavioral change over time [19]. The ÉPICO project incorporated a holistic view of behavior that emphasizes the relationship of intentions to health behaviors. By training CHWs to disseminate cancer education messages, the ÉPICO project aimed to change intentions for cancer prevention behaviors among South Texas community residents. Specifically, CHW training of residents aimed to increase preventive knowledge specific to breast, cervical, and colorectal cancers; these cancers have consistently had some of the highest incidence rates in the target population [20]. Improvements in such knowledge among residents from baseline are necessary conditions for the success of the ÉPICO intervention.

Accordingly, this manuscript aims to investigate what particular factors predict this knowledge development among

residents. Resident knowledge gain can be theorized to result from resident characteristics. This manuscript focuses on two critical characteristics: residents' behavioral intention and perceived source factors. Also critical is residents' perceptions of the CHW who trained them. The literature on source factors has well documented how such perceptions are critical in the process of persuasion. Often, the most important source factor is perceived communicator credibility, which entails judgments by the message recipient of the communicator's believability [21]. Following the literature, one can postulate that residents who perceive their CHW educator to be credible will, thus, be most likely to learn from the training.

In addition to the effects of resident characteristics on their knowledge gain, we propose that the characteristics of the CHWs delivering the intervention also play a role. In this regard, we suggest a direct correlation between residents' knowledge gained from the intervention and the CHW's educational attainment and experience as a CHW. With this multilevel lens, knowledge develops according to the relative influence of resident characteristics *and* CHW characteristics in predicting resident cancer knowledge. The current investigation can build knowledge specific to ÉPICO in the *colonias* along the USA-Mexico border in South Texas and, more broadly, knowledge related to the development of a replicable, sustainable CHW training program on prevention, treatment, and healthy survivorship for colorectal, breast, and cervical cancers.

Methods

ÉPICO was approved by the Texas A&M Health Science Center Institutional Review Board. ÉPICO was conducted between October 2011 and December 2013 in the Lower Rio Grande Valley, Texas, including the *colonias* in this region. Six full-time bilingual and bicultural CHWs, project directors, program staff, and content experts developed a series of culturally competent cancer education training modules for CHWs to use with at-risk Hispanic populations and CHWs. The Spanish and English language training curricula were certified by the Texas Department of State Health Services. The six ÉPICO CHWs recruited community residents living in *colonias* in the Lower Rio Grande Valley and delivered these trainings predominantly in Spanish and less frequently in English. Consenting residents completed pre-tests, post-tests, and evaluations when participating in the intervention. The project team used a sampling method to select groups (every fourth group of randomly selected *colonias*) to ask residents to complete a socio-demographic survey. Of those residents completing the demographic survey, the project team randomly selected a subset to complete follow-up surveys about 2 months post-training.

Intervention

Data come from in-person surveys and telephone survey interviews with CHWs and residents who received the intervention. In the second quarter of project year 1 (January–March 2012), the ÉPICO CHWs completed a state-endorsed CHW instructor certification program and received certified training on message tailoring. The ÉPICO team developed, pilot tested, and revised the bilingual training modules covering prevention/early detection, treatment options, and healthy cancer survivorship for breast, cervical, and colorectal cancers. In year 2, ÉPICO CHWs implemented the intervention directly with Lower Rio Grande Valley residents.

Data Collection

CHW data collection is from the six ÉPICO CHWs trained as Texas-certified CHW instructors (January–December 2012). Descriptive statistics for these CHWs are depicted in Table 1. These CHWs had a mean education level of 13.32 years, a mean age of almost 46 years old, and had more than 10 years of experience working as a CHW. They were all Hispanic.

In project year 2 (December 2012–July 2013), ÉPICO *promotores* delivered tailoring-based training as part of their outreach activities to residents of the Lower Rio Grande Valley. A total of 3560 residents received the training, and of these, 2917 consenting residents completed a printed pre-test questionnaire to ascertain baseline knowledge, attitudes, and

behaviors. Immediately following the trainings, these same residents ($N=2917$) completed a printed post-test questionnaire and evaluation. A subset of residents ($N=1145$) completed an additional demographic survey. An average of 2 months following the training, a follow-up survey was conducted via telephone with a subsample of residents, accomplished by calling every fifth consenting resident ($N=307$) to request participation. A total of 147 residents completed the follow-up survey, which had measures specific to cancer knowledge, attitudes, and behaviors and survivorship questions pertaining to quality of life indicators and resource access. Response rates were as follows: pre-test and post-test, 81.9 % and 3-month post-test, 47.9 %. These three surveys were panel in nature, with individual respondents completing interviews at more than one point in time. Additionally, resident responses from the three data points can be linked to the specific ÉPICO CHW by whom they were trained. As shown in Table 1, almost all trained residents were female and Hispanic, with mean formal education below “high school graduate/GED” and household income nearing “\$20,000 but under \$30,000.”

Measurement and Data Analysis

Data were analyzed collectively for training on each of the three types of cancer. Three types of statistical analysis were conducted with Stata 13. First, analysis of variance (ANOVA) was conducted on resident cancer prevention knowledge at the three points in time. We measured cancer prevention knowledge in terms of percent correct out of 20 questions at pre-test and at post-test, as well as eight questions at 3-month post-test. These items assessed resident knowledge of information disseminated by CHWs during the ÉPICO intervention.

Second, panel data analysis with Stata’s *xtnet* function was used to assess the resident predictors of change in cancer prevention knowledge over time. Control variables included resident age, education, household income, gender, and ethnicity. Resident perceptions of CHW credibility was measured with two items in the post-training evaluation—CHW satisfaction and CHW trust ($r=.646, p<.001$). Satisfaction was on a scale from “very unsatisfied” (1) to “very satisfied” (4), and trust was on a scale from “distrust” (1) to “trust” (3). Resident lifestyle change intentions was specific to use the training information to make subsequent lifestyle changes related to cancer prevention, with responses from “not at all likely” (1) to “extremely likely” (4). General health information involved how many times residents had previously obtained health information from non-ÉPICO CHWs, with responses from 0 times (0) to 10 or more times (4). Resident attendance of previous non-ÉPICO cancer trainings was also measured, with responses from 0 times (0) to 10 or more times (4). To address normality issues, we ran log transformations on cancer prevention knowledge, lifestyle change intentions,

Table 1 CHW and resident demographics

	<i>N</i>	Mean	SD	Min	Max
CHWs					
Female	6	94.50 %		0	1
Education	6	2.52	1.12	1	5
Age	6	48.20	10.31	20	73
CHW work years	6	7.63	6.60	0	31
Residents					
Female	2871	94.98 %		0	1
Hispanic	2871	98.58 %		0	1
Age	2871	38.68	12.27	11	92
Education	2871	4.14	2.04	0	11
Household income	2871	1.58	1.31	0	10
Behavior change intentions	2871	2.82	0.40	1	4
Perceptions of CHW credibility	2871	3.89	0.30	2	4
Prior CHW health information	2871	1.53	0.81	1	5
Non-ÉPICO cancer trainings	2871	1.42	0.73	1	5
Cancer prevention knowledge					
Pre-test	2871	69 %	21 %	0	1
Post-test	2871	81 %	20 %	0	1
6-month post-test	148	74 %	22 %	0	1

perceptions of CHW credibility, general cancer information, and participation in non-ÉPICO cancer trainings.

Third, multilevel analysis was used to determine what factors predicted patterns in resident cancer prevention knowledge between pre-test and post-test. The dependent variable was the change in cancer prevention knowledge from pre-test to post-test. In this analysis, individual residents were nested within CHWs. There were independent variables at the resident level and at the CHW level. We ran two such models: (1) a full unconditional model, which determines whether there is significant variance at the CHW level, and (2) a random intercept full conditional model, which specifies the effects of resident-level and CHW-level factors. Interclass correlations (ICC) are reported, which indicate what percent of variance is at the CHW level.

Results

ANOVA indicated significant variance in cancer prevention knowledge across the three panel surveys, $F=333.56, p<.000$. Scheffe post hoc indicated a significant difference in cancer prevention knowledge between each of the survey comparisons: pretest versus post-test, $p<.000$; pre-test versus 3-month post-test, $p=.005$; and post-test versus 3-month post-test, $p<.000$. In particular, resident cancer prevention knowledge increased significantly from pre-test (69 % correct) to both post-test (81 % correct) and 3-month post-test (74 % correct). There was evidence of significant decay from post-test to 3-month post-test.

For the panel data analysis, a significant Hausman test ($\chi^2=32.54, p<.001$) suggested the use of a fixed effects model. Table 2 depicts the effects of this analysis at the individual level. The overall R^2 was .11. After controlling for demographics and other variables, resident cancer prevention knowledge correlated with the progression of time, from pre-test to post-test to 3-month post-test ($\beta=.18$). Additionally, both lifestyle change intentions ($\beta=.11$) and perceptions of

CHW credibility ($\beta=.21$) significantly predicted resident cancer prevention knowledge. Importantly, neither the general cancer information nor non-ÉPICO training measures were a significant predictor, which helps mitigate alternative explanations for knowledge change.

The multilevel analysis indicated that the intercept in the full conditional model was significant ($b=.12$) (see Table 3). This finding demonstrates that resident levels of cancer prevention knowledge varied according to which CHW trained them. The ICC indicates that almost 12 % of variance occurs at the CHW level. The random intercept model specifies that resident cancer prevention knowledge was associated with CHW education ($b=.03$), but inversely associated with CHW age ($b=-.01$) and years as CHW ($b=-.02$). At the resident level, resident cancer prevention knowledge was inversely correlated with resident education ($b=-.01$) and positively correlated with resident perceptions of CHW credibility ($b=.32$).

Discussion

Importantly, resident preventive knowledge on the three focal cancers increased from baseline to post-test and 3-month post-test. This trend indicates that the ÉPICO project effectively increased cancer prevention knowledge among residents. While there is evidence of significant knowledge decay from post-test and to 3-month post-test, such decay is an intuitive long-term outcome in health education programs [22]. The knowledge increase is, as expected, more pronounced immediately following the training than 3 months later. This finding is important because many campaign evaluations limit their assessment to short-term changes in knowledge.

Additionally, statistical analyses underscored the critical role of residents' perceptions of CHW credibility. This variable played the strongest role in predicting resident cancer knowledge at both the individual level and multilevel. These findings are especially impressive when considering: (1) the

Table 2 Fixed effects regression model on predictors of resident cancer prevention knowledge ($N=2871$)

	Unstandardized coefficient	<i>p</i> value
Resident age	0.00	.005
Resident education	0.02	.000
Resident household income	0.00	.448
Resident gender	-0.06	.000
Resident Hispanic	-0.07	.317
Time	0.18	.000
Resident lifestyle change intentions	0.11	.000
Resident perceptions of CHW credibility	0.21	.000
Resident prior CHW health information	0.00	.906
Resident participation in non-ÉPICO cancer trainings	-0.02	.363

Table 3 Multilevel regression model on predictors of resident cancer prevention knowledge (N=2871)

	Full model		Random intercept model	
	Unstandardized coefficient	<i>p</i> value	Unstandardized coefficient	<i>p</i> value
Mean as outcome (CHW-level predictors)				
Intercept	0.12	.000		
CHW education			0.03	.038
CHW age			-0.01	.281
Years as CHW			-0.02	.000
Slope coefficient (Resident-level predictors)				
Resident age			0.00	.281
Resident education			-0.01	.567
Resident household income			0.00	.567
Resident gender			0.02	.510
Resident Hispanic			-0.03	.544
Resident lifestyle change intentions			0.02	.378
Resident perceptions of CHW credibility			0.32	.000
Resident prior CHW health information			-0.02	.313
Resident participation in non-ÉPICO cancer trainings			0.01	.720

limited variance in the measurement of perceptions of CHW credibility and (2) that the current analyses accounted for the effects of control and other variables. This documented role of credibility is consistent with prior research demonstrating the strong effects of credibility perceptions on communication effects [21]. The related literature shows that adult learners in multiple contexts exhibit improved knowledge transfer and retention when they perceive the trainer and training positively [23]. The ÉPICO findings related to lifestyle change intentions, however, were mixed. While this variable had a sizable and significant effect in the individual-level model, its effect was non-significant in the multilevel model. This change illustrates the value of considering both individual-level and multilevel processes. The multilevel process is more realistic and more comprehensive because it captures not only the characteristics of individual residents but also the characteristics of CHWs. This multilevel approach, thus, takes into account the individual and relationship levels of the social ecological model [8].

CHW characteristics played an important role in the multilevel analysis. In particular, CHW education level was associated with the subsequent knowledge gain of the residents whom they trained. This suggests that the more educated a CHW, the more effective instructor she will be. In addition, CHWs with more experience were actually less effective as regards to building cancer knowledge among residents. At first, this may be surprising, but this finding may suggest that less experienced CHWs were more open to the ÉPICO

project’s evidence-based approach to conducting outreach. While less experienced CHWs seem to have been open to new ideas and approaches, their more experienced counterparts may have been “stuck in their ways,” experiencing dissonance and, thus, being adverse to the adoption of new approaches such as message tailoring in their outreach activities. This is consistent with findings from other cancer education projects, where newly recruited community-based trainers are more successful in building cancer knowledge than more experienced educators who use traditional didactic methods [24, 25].

Six features of this study should be noted. First, the use of panel data allows the derivation of inferences of causation. Second, another strength of the current study is the implementation of analysis at both the individual-level and multilevel, which permits a nuanced comparison of results. Third, the inclusion of control and other variables in the analyses helps negate some alternative explanations for the documented processes. At the individual level, these variables included resident demographics, behavioral intention, credibility perceptions, and—importantly—prior exposure to CHW health information and cancer trainings. Importantly, the non-significant effects of prior exposure provide evidence that the increase in resident cancer knowledge resulted from ÉPICO and not from other cancer prevention initiatives. At the CHW level, education, age, and years of experience were also inserted in the model. Fourth, the results of this study should be generalized only with caution beyond ÉPICO.

ÉPICO is a novel health intervention, functioning in the unique context of the *colonias* along the USA-Mexico border in South Texas. Fifth, there is the possibility of response bias in the self-report items. Such bias, though, should be mitigated by the residents' familiarity with CHWs and the confidentiality of all questionnaires and tests. Sixth, with any panel data analysis, there is the possibility of testing bias, in which being questioned at baseline can alter how answers on subsequent surveys.

In conclusion, the current study offers several potentially important lessons in terms of how a health program should use CHWs. The findings highlight the importance of engaging CHWs who will be perceived to be highly credible in the communities where an intervention will occur. Future research should provide refinement to the current findings on perceived credibility by employing measurement of credibility's two sub-dimensions: trustworthiness and expertise [21]. The findings also raise questions as to whether CHW training initiatives such as ÉPICO would be best served by employing seasoned CHWs or CHWs who are relatively new to the field. The current study found that less experienced CHWs were the most effective in their resident outreach. Further research on CHW characteristics related to experience and education is a promising avenue of inquiry. More broadly, the results of this study suggest the effectiveness of the ÉPICO model. The effects in the short-term were strong and, though decaying somewhat, remained sizable 3 months after the intervention. Understanding ÉPICO's use of CHWs and message tailoring, as well as the intervention outcome trends and their individual-level and multilevel predictors can inform future community-based health education projects, especially those targeting at-risk Hispanic populations in low-resource settings.

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