ORIGINAL RESEARCH

Measuring the Efficacy of a Pilot Public Health Intervention for Engaging Communities of Puerto Rico to Rapidly Write Hurricane Protection Plans

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Keywords: community engagement; disaster risk reduction; population protection measures; public health emergencies; public health intervention

Abbreviations:
CDC: Centers for Disease Control and Prevention
KSA: knowledge, skills, and abilities
NGO: nongovernmental organization
O2C3: Operational, Objective-based, Consensus-based, Capability-based, Compliant
PPM: personal protection measure
RCM: Risk Communication Meeting
SOAR: Strategy, Objective, Activity, Responsibility
SPW: Strategic Planning Workshop
TPW: Tactical Planning Workshop
TTX: Tabletop Exercise

Abstract

Objective: The efficacy is measured for a public health intervention related to community-based planning for population protection measures (PPMs; ie, shelter-in-place and evacuation).

Design: This is a mixed (qualitative and quantitative) prospective study of intervention efficacy, measured in terms of usability related to effectiveness, efficiency, satisfaction, and degree of community engagement.

Setting: Two municipalities in the Commonwealth of Puerto Rico are included.

Participants: Community members consisting of individuals; traditional leaders; federal, territorial, and municipal emergency managers; municipal mayors; National Guard; territorial departments of education, health, housing, public works, and transportation; health care; police; Emergency Medical Services; faith-based organizations; nongovernmental organizations (NGOs); and the private sector.

Intervention: The intervention included four community convenings: one for risk communication; two for plan-writing; and one tabletop exercise (TTX). This study analyzed data collected from the project work plan; participant rosters; participant surveys; workshop outputs; and focus group interviews.

Main Outcome Measures: Efficacy was measured in terms of ISO 9241-11, an international standard for usability that includes effectiveness, efficiency, user satisfaction, and "freedom from risk" among users. Degree of engagement was considered an indicator of "freedom from risk," measurable through workshop attendance.

Results: Two separate communities drafted and exercised ~60-page-long population protection plans, each within 14.5 hours. Plan-writing workshops completed 100% of plan objectives and activities. Efficiency rates were nearly the same in both communities. Interviews and surveys indicated high degrees of community satisfaction. Engagement was consistent among community members and variable among governmental officials.

Conclusions: Frontline communities have successfully demonstrated the ability to understand the environmental health hazards in their own community; rapidly write consensus-based plans for PPMs; participate in an objective-based TTX; and perform these activities in a bi-lingual setting. This intervention appears to be efficacious for public use in the rapid development of community-based PPMs.

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Introduction

Extreme weather events are expected to affect the health status of millions of people.[1] Small islands (like Puerto Rico) are especially vulnerable to these effects of climate change.[1] It has been posited that climate change adaptation needs to become part and parcel of comprehensive disaster risk management.[2,3] Reducing disaster risk requires long-term engagement and is largely a task for local actors (with support from national organizations).[2,4] The National Academy of Sciences (Washington, DC USA) has recognized community engagement as a critical component of disaster-related decision making, planning, and risk reduction measures that will promote healthy outcomes.[5,6]

However, for communities to protect themselves from disaster-related hazards, they must first be able to assess *their own* risks, plan *their own* interventions, and then measure *their own* effectiveness. The most effective disease interventions are known to prevent human exposure to the health hazard. Population protection measures (PPMs; ie, shelter-in-place and evacuation) are an effective means for preventing exposure (and therefore adverse health effects) due to environmental hazards. But (as the COVID19 crisis has exemplified), in order to become applicable in the real-world, PPM interventions that restrict or direct population movements must also be developed through community participation.[7] Public health has a long history of community-based participatory research and interventions for managing health risks due to a range of hazardous exposures.[7]

However, a research-practice gap exists across all fields of public health and medical practice, including disaster-related health science:[8,9] "Our inability or unwillingness to apply what is known to improve health results in significant health deficits and persistent inequalities."[8] In fact, there is no evidence of significant change in US disaster-related mortality rates over the past 50 years (1969-2018) despite billions of dollars in public outlays.[10] Health inequity has persisted for decades among US minorities affected by disasters.[11] Recent events have raised public concern regarding systemic inequality during public health emergencies, such as Hurricane Maria (2017) and the COVID19 pandemic.[12,13]

Public health has moved forward in recent years to bridge the research-practice gap. Evidence-based public health calls for knowledge of the determinants and consequences of disease, as well as the efficacy, effectiveness, and costs of interventions.[14,15] Many health departments are now pioneering a new "Public Health 3.0" model in which leaders partner across multiple sectors and are leveraging actionable data and clear metrics to address the social, environmental, and economic determinants of health and inequity.[16]

And while effectiveness research is commonplace in other areas of public health, there have been few studies of intervention effectiveness related to disasters (eg, hurricanes). Despite repeated urging of public health leadership, disaster epidemiology remains chiefly concerned with etiological, rather than evaluative, hypotheses.[17,18]

This study applied a mixed methodology to test the efficacy of an innovative public health intervention for engaging high-risk island communities to rapidly write their own population protection plans for hurricanes. Efficacy is here measured in terms of the international standard for "usability," defined as "the extent to which a system can be used by specified users to achieve specified goals with effectiveness, efficiency, satisfaction, and freedom from risk."[19,20] Efficacy is a measure of the performance of an intervention under *controlled* circumstances (as compared to effectiveness, which is a measure of performance under *"real-world"* conditions).[21] Measures of efficacy and effectiveness describe the quality of outcomes, as compared to efficiency that describes the quality of performance (usually as a rate).

Satisfaction is a user-focused measure of quality. In simple terms, it involves "ensuring value" for the project participant. Participant value is a function of the relative risk of engagement (ie, economic, social, environmental, and health) compared to the benefit of engagement.[19] Community engagement is therefore influenced by perceptions of risk associated with the intervention.

Methods

Description of the Planning Process

The planning method used for this intervention was based upon a previously described process developed at the Centers for Disease Control and Prevention (CDC; Atlanta, Georgia USA) that applies an Operational, Objective-based, Consensus-based, Capability-based, and Compliant, or "O2C3," approach for plan writing and a Strategy, Objective, Activity, Responsibility, or "SOAR," structure for organizing plan content.[22,23] This same methodology has demonstrated plausibility and reports of cross-cultural transferability among academic and governmental settings in over 200 jurisdictions world-wide.[24–26]

The "O2C3" planning is a facilitated *process* of group plan-writing that is: objective-based (O); written at an operational level of detail (O); consensus-based (C); capability-based (C); and compliant (C) with local and national cultural norms, policies, and regulations.[22,23]

The "SOAR" acronym is used to describe the *organizational structure* (ie, data schema) for information stored in the plan. The achievement of each protection plan capability is described in a cascading level of detail starting from the (S) strategic goal (S); to the operational objectives (O) that accomplish that goal; to the activities that accomplish each objective (A); and parties responsible for performance of each activity (R).[22]

The population protection plan is organized in a hierarchical fashion starting with 12 core capabilities. Table 1 lists these core capabilities that were identified for PPMs based upon the US Department of Homeland Security (Washington, DC USA) "hub and spoke model" for evacuation.[27]

For each of the 12 capabilities, each element of SOAR was proposed, read aloud, discussed, and then decided by group consensus. The SOAR elements were transcribed into spreadsheet format using Excel (Microsoft 365; Microsoft Corp.; Redmond, Washington USA). The spreadsheets were created in both English and Spanish, and then both versions were simultaneously shared on a large projection screen for the entire group to view together.

This process was facilitated in a plenary setting using a consensus-based approach for decision making.

Project Design

During a one-year term, the authors implemented a pilot project in two municipalities of Puerto Rico to test an innovative, community-based approach for disaster risk reduction. Municipality A (census = 50,000) is located on the coastline where it is at high risk for hurricane-related wind, coastal storm surge, and riverine flooding. Municipality B (census = 25,000) is located in the mountains, and is at high risk for hurricane-related wind, landslides, and riverine flooding.

The intervention is designed to prevent human exposures to hurricane hazards (eg, wind, landslides, floods, and storm surge)

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Public Education
Hazard Monitoring
Population Alert and Warning
Plan Activation
Population Staging
Transportation
Guest Registration and Tracking
Mass Care
Health and Safety
Communications and Documentation
Coordination
Monitoring and Evaluation

Table 1. Core Capabilities Included in the Population Protection Plan

BEFORE they occur. The project, known as "Plan to Protect," focused on early advance evacuation of families with members that were children (<5 years old) and/or elderly (>65 years old). Table 2 provides a logic model for the project.

To initiate the project, implementing team members convened in Puerto Rico to develop 13 project objectives that would achieve the five project goals stated in the award. Using a facilitated, consensus-based approach (based upon the O2C3 method), the team then drafted 72 activities that would accomplish these 13 objectives.[22,23] The group also assigned primary responsibility and a deadline for completion for each activity.

The strategy included four community convenings. During the first convening, the *"Risk Communication Meeting"* (RCM) participants learned about hurricane-related health risks specific to their community. Next, the team used the O2C3 planning method to facilitate a community-level *"Strategic Planning Workshop"* (SPW) to generate a strategic-level plan (ie, one containing only S - strategic goals and O - operational objectives).

Once a strategic plan was developed, the study then compared two separate methods (eg, exercise and plan-writing) to add tactical-level of detail (ie, A - activities and R - responsible parties) to the plan content. This was compared for two separate methods: (1) a modified *"Tabletop Exercise"* (TTX); and (2) a *"Tactical Planning Workshop"* (TPW). All workshops were assisted by simultaneous, English-Spanish translation. All written materials were provided in both English and Spanish versions.

Planning workshops (SPW and TPW) used a standardized international O2C3 model for capability-based planning according to the SOAR organizational format developed by the CDC.[22,23] The TTX used a standardized US national model, *America's PrepareAthon Facilitators and Evaluators Handbook for Whole Community Tabletop Exercises: Hurricane*, developed by the US Federal Emergency Management Agency (FEMA; Washington, DC USA).[28]

Study Design

The study measured the efficacy of a community-based planning intervention for achieving the intended short-term outputs and outcomes. Efficacy was measured in terms of ISO 9241-11, an international standard for usability that includes effectiveness, efficiency, user satisfaction, and "freedom from risk" among users.[20] Table 3 provides a detailed listing of indicators used for measuring efficacy in terms of effectiveness, efficiency, satisfaction, and degree of engagement (used here as an indicator of "freedom from risk").

Data related to the following sources were entered into and analyzed using Excel.

Review of Work Plan Documentation—All project activities were documented according to a time-bound workplan developed by team consensus. Times and dates of actual completion were documented for all objectives and activities and then compared to deadlines.

Review of Workshop Outputs—Workshop outputs and timelines were reviewed for effectiveness (in terms of completeness and accuracy in details) and efficiency (in terms of outputs/hour). Community plan outputs from the three interactive workshops (SPW, TTX, and TPW) were analyzed.

The number of plan objectives written and number of hours worked were documented for the SPW. Completeness was calculated as the percentage of plan objectives (or activities) written by the community out of all objectives (or activities) that were planned to be completed during that specific workshop. Presence or absence of a designated responsible party was also recorded for each activity of the plan. Completeness was calculated as a function of the percentage of entries that included designation of party responsible for completion of each activity.

Efficiency rates for strategic-level planning were calculated for SPW outputs as the number of strategic and operational-level objectives completed per hour. Efficiency rates for the TTX and TPW were calculated as the number of tactical-level activities completed per hour. Responses were also categorized and scored according to the level of detail provided in the description of each activity. Four team members served as independent reviewers. Blank entries were scored as zero; one-word entries were scored as one; unintelligible phrases were scored as two; intelligible phrases were scored as three; and intelligible full sentences were scored as four. Descriptive statistics including means and confidence intervals were calculated for the reviewers' mean scores of tactical-level detail. A threshold for "adequacy" of tactical-level detail was defined as any score ≥3.0 where on the whole, entries are, at minimum, deemed "intelligible" by four separate reviewers. Plan activities were compared for TTX and TPWs plans developed in both communities. The same reviewers provided scoring for the same sets of variables. All reviewers were blinded to the type of workshop (eg, TTX or TPW) and the community of origin for the data they reviewed. In addition, the number of plan activities without a corresponding assignment of responsible party was tallied from protection plans that resulted from both TTXs and the TPWs. Percentages were calculated for any plan activities lacking an assignment of responsibility out of all activities listed during each TTX and TPW.

Survey of Workshop Participants—Participants were surveyed anonymously by paper questionnaire. At the end of each of four community convenings, respondents were asked to use a five-point Likert scale for assessing their own knowledge, skills, abilities (KSAs), attitudes, and beliefs regarding the project, in general, and that specific workshop (eg, RCM, SPW, TTX, or TPW). Percentages of participant agreement with a five-point Likert scale were used to assess qualitative statements about the four community convenings. Responses to qualitative statements were classified according to the following three categories: "agree," "neutral," and "disagree." Participant selections of "strongly disagree" and

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"disagree" on the Likert scale were combined into one category entitled "disagree." Participant selections of "strongly agree" and "agree" on the Likert scale were combined into one category entitled "agree." No changes were made to selections for "neutral."

Review of Workshop Participant Roster—A roster of workshop participants was maintained to include participant's name and affiliation. Attendance was recorded for each of the workshops, according to one of the following affiliations: federal, territorial, municipal, nongovernmental organizations (NGO), and members of the general community.

Focus Group Interviews—An independent evaluator (not involved in the planning or exercises) conducted a one-hour-long, in-person focus group interview with six self-selected individuals from each target community. Community members were asked a series of open-ended questions related to their KSAs, attitudes, and beliefs related to the workshops. Participants received a $25 gift card as incentive.

The same evaluator also conducted one telephone focus group interview with local project staff members. Three individuals participated. Locally based project staff members were asked open-ended questions related to their KSAs, attitudes, and beliefs related to the workshops.

Ethics

This study was ethically reviewed, approved, and performed under a sole source contract funded by the CDC, administered by the US Association of State and Territorial Health Officials (ASTHO). The CDC reviewed and approved the work plan and publication for this project prior to implementation.

Results

Results from Review of Project Work Plan

A comparison of the final project documentation according to the workplan timeline revealed the successful on-time completion of 13 (100%) of the 13 project objectives and 71 (99%) of the 72 project activities within 12 months, as intended.

Results from Review of Project Outputs and Outcomes

Both communities (comprising an average of 35 persons representing 19 agencies and the public) demonstrated the ability to draft and exercise their own hurricane population protection plan (averaging 60 pages long), within a duration of 14.5 total hours from start to finish.

Table 4 provides a summary of the results from a review of outputs and timelines (in terms of the degree of plan completeness; rate of plan-writing; and degree of tactical detail in the plan) for each of the three workshops held in each of two target communities.

Effectiveness—The SPWs were 100% effective in both communities for the writing of all objectives identified (by both communities) as necessary for effective implementation of the 12 core capabilities included in each plan.

The TPWs were 100% effective in both communities for the writing of all activities identified (by both communities) as necessary for effective implementation of the 75+ objectives included in each plan.

During the TTXs, Communities A and B effectively completed 86% and 81% (respectively) of the activities associated with objectives previously developed in the SPWs.

The overall mean reviewer scores of tactical-level detail in plans resulting from TTXs were nearly identical at an estimated 2.51 (CI, 2.40-2.61) and 2.50 (CI, 2.38-2.61) for Community A and B, respectively. Reviewers' estimates of tactical-level detail were also notably similar for plans resulting from the TPWs (3.56 [CI, 3.51-3.59] and 3.59 [CI, 3.54-3.63]) for Community A and B, respectively. This similarity may imply a certain degree of reproducibility. In addition, on face value, TPW levels of tactical detail appeared one-third higher as compared to that generated in a TTX. However, the probability distribution of this relatively small data set did appear to have a slightly negative skew (range -1.1 to +0.5) with a kurtosis of (-0.9 - +0.7), thus hampering accurate parametric comparison between TTX and TPWs.

Finally, the mean percentage of plan activities that included no assignment of tactical-level responsibility (scored yes or no by one blinded reviewer) was identified as 78% and 80% for Communities A and B, respectively, during TTXs. In comparison, the mean percentage of plan activities that included any assignment of tactical-level responsibility (scored yes or no by the same reviewer) was estimated as 0% for both communities during TPWs. This similarity may again imply a certain degree of reproducibility and efficiency in the TPW model as compared to TTX (especially since this involved a simple binary [present/absent] tally of the entire dataset, as compared to a subjectively-scored sample).

Efficiency—Overall, the time-efficiency of strategic planning (objectives only) also appeared reproducible and nearly the same for SPWs in both communities (14.0 objectives/hour and 14.4 objectives/hour, respectively). On average, there were 21% less plan activities written during the TTX as compared to the TPW. However, the duration of the TTXs was also 20% less than the TPWs. Thus, the time-efficiency (in terms of number of activities completed per hour) was nearly equal for TTX and TPW in both communities. The TTX participants appeared able to write plan activities at the same rate as they did during the TPW, but with less detail. However, the non-normal sample distribution did not allow for an accurate comparison of this difference.

Results of Survey Related to Workshop Participant KSAs and Attitudes

Table 5 lists the percentages for participant agreement (using Likert scales) to assess qualitative statements about the four community convenings (n = 198, response rate = 71% of all attendees). Nearly all (>90%) of participants agreed that: (1) workshops met their intended objectives; (2) the content was relevant to work, community, and family; (3) the material was clearly presented and easy to understand; (4) the exercise was well organized; (5) participant comments were welcomed; and (6) participants had a good understanding and were supportive of the project. Eighty percent of community members agreed that they had demonstrated the ability to implement a health risk reduction plan with community consensus.

Results from Review of Participant Roster

Table 6 provides a summary of participation in the four community convenings, according to affiliation of the stakeholder.

Convenience Sample Data from Focus Group Interviews, Summarized by Indicators of Usability

Effectiveness—Strengths: Participants mentioned the benefit of participating in a rapid, collaborative planning process and were eager to try the approach in their work. Participants appreciated

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that the planning process was broken down into clear steps. Weaknesses: Participants requested an additional community meeting to decide how to take action based upon the risks. Implementing staff expressed a desire for more training and practice before initiating the project.

Efficiency—Strengths: Participants appreciated the benefit of having everyone in one place at one time to "speak the same language" about disasters. Participants liked when the facilitator had time to explain concepts, but also appreciated when they prevented them from dwelling on any one topic for too long. Weaknesses: While simultaneous translation was readily available, it was suggested that use of bilingual co-facilitators would encourage people to speak up more. Participants also suggested providing for better control of off-topic conversations.

Community Satisfaction—Strengths: The participants in both communities found the workshops valuable. Participants mentioned the benefit of creating new and strengthening existing partnerships within the community. Weaknesses: Participants expressed doubt that the plans would be approved and adopted by the government and worried that elected and appointed leaders were too transient to be relied upon for continuity. They expressed a desire for stronger community leadership.

Community Engagement—Strengths: Participants expressed an appreciation to engage with community residents and learn more about their needs and concerns. Likewise, some felt community engagement provided an opportunity for agencies to demonstrate to the public that they are working to protect them from harm. Weaknesses: At times, participants recognized that important agencies and organizations were missing from the conversation. Participants also voiced the need for more engagement from municipal, central, and federal agencies.

Discussion

Population Protection Measures

Population protection measures have become more important to emergency management operations in recent decades.[27] In March 2020, 42 US states were under shelter-in-place orders: a total of 308 million people, or 94% of the US population.[29] Recent events further underscore the need for community engagement in support of public health interventions that involve PPMs. And yet, there is little scientific evidence available related to the effectiveness or efficiency of public health interventions that would assist communities to perform these PPMs.

The challenge is to tailor the PPM to best address a variety of factors, including a community's demographics, location, infrastructure, resources, authorities, and decision-making processes.[27] For this to occur, the respective roles and responsibilities of individuals, families, governments, NGOs, and the private sector must be negotiated and mutually agreed upon in advance. Population protection plans must also be written at an operational level of detail to capture the unique demographics, capabilities, and risks of the community. Public health is uniquely positioned at the local level to facilitate this process with its long history of "town-hall style" community engagement, especially related to reducing hazardous exposures.[7,29]

Community Engagement

Community engagement is a useful approach for obtaining public input about policy decisions that require *difficult choices among competing values* (eg, PPMs). According to the National Academies of Science, "Although average citizens may lack the expertise to comment on technical issues, they are very capable of deliberating on the values underlying public policy decisions in crisis situations."[6]

Besides effectiveness and efficiency, the usability of any public health intervention (including PPMs) is also influenced by the degree of satisfaction and "freedom from risk" perceived among participants.[19,20] To be usable, public health interventions related to PPMs must not only be effective and efficient, they must also be perceived by the community to have a value that outweighs potential social, economic, environmental, or health risk.

While the risk of engagement was indeed negligible related to economic, health, or environmental threats, some participants in this study (particularly those in positions of authority or responsibility) may have perceived a social risk related to their participation during the workshops. Social risks may include the potential to appear that one (or one's agency) is: (1) poorly informed; (2) poorly suited to perform a task for which one is responsible; (3) overly cooperative with a rival group; or (4) unwilling to commit responsibility for activities identified in the plan.

It appears that the most usable PPMs engender a high degree of community satisfaction with the engagement *process*, as well as the intervention *content*. Satisfaction is a participant-focused measure of value. Participant value is a function of the relative risk compared to the benefit of engagement in the workshops.[19,20] Thus, the usability of an intervention is also dependent upon a perceived "freedom from risk" on behalf of the participants. The most usable PPMs take into consideration economic, social, environmental, and health risks that may influence the full range of public and private community members (perhaps a good lesson for the current challenges of COVID19 public health interventions related to PPM [ie, shelter-in-place]).

Finally, to be a fair broker of the public trust, community-based interventions must encourage the collaboration of professional partners while remaining committed to a "partnership of equals" and producing outcomes of value to the entire community (not just the "official" organizations).[7,30] The use of consensus-based decision making during the planning process allowed for *equitable partnerships* during this process – a key element of community satisfaction and risk perception.

Consensus aims to be inclusive, participatory, cooperative, and egalitarian.[23] Consensus-based decision making not only seeks agreement, but also to *resolve or mitigate the objections of the minority* to achieve the most agreeable decision. Consensus-based decision making serves to incorporate the socio-economic and cultural input of community in all aspects of the process, encouraging stakeholdership and commitment. The process results in equitable partnerships that require the sharing of power, resources, credit, results, and knowledge, as well as a reciprocal appreciation of each partner's knowledge and skills (as was noted in the results of the focus group analysis).

Limitations of Study

Descriptive studies typically lack causality and are prone to bias. However, the validity of such findings can be greatly enhanced by studies such as this that suggest the intervention is having an important effect and perhaps warranting of more detailed observational trials.[21,31]

This study was designed to measure efficacy which, by definition, occurs under well-controlled conditions. And while documentation of the efficacy, reproducibility, and transferability of this process are important prerequisites for implementation and dissemination of this intervention, it will be necessary to study this intervention in a larger number of applications over time in order to

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ascertain its effectiveness in terms of public health practice and health outcomes.

Conclusions

Frontline communities have successfully demonstrated their ability to understand the environmental health hazards in their own community, rapidly write consensus-based plans for PPMs, participate in an objective-based TTX, and perform these activities in a bi-lingual setting. This intervention appears to be efficacious for public use in the rapid development of community-based PPMs. More study is needed to ascertain impact on practice and health outcomes over the medium and long term.

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Component	Goal	Activity	Process	Expected Outputs	Expected Outcomes
Project Planning	A workplan is available to guide project management	Partner meeting	O2C3 planning method with facilitator	A project workplan is available	100% of team members reach consensus regarding project objectives, activities, and responsibilities
Project Implementation	The workplan is implemented on time and within budget	Operations management	Management by objectives, according to a timeline	100% of project deliverables are available	100% of deliverables are available for use in implementing the intervention and 100% of project objectives are accomplished on time
Risk Assessment	An assessment of disaster-related health risk is performed for host communities	Data collection and analysis	Hazard-impact analysis using a proprietary tool for estimating the likelihood of: ○ Hurricane hazards ○ Exposure ○ Vulnerability ○ Capacity	Two presentations are available in Spanish and English and four maps of community social vulnerability are available	100% of team members recognize the use of hazard impact analyses for estimating disaster risk and Hazard impact analyses and vulnerability maps are available to guide community decisions
Risk Communication Meeting (RCM)	Community members are aware of the health hazards in their community, related to hurricanes	Community knowledge workshop	Public presentation with facilitated community Q&A discussion	Printed handouts of the presentation are available in Spanish and English and a survey of participant knowledge/attitudes/beliefs	Community members demonstrate that they are aware of the health hazards in their community, related to hurricanes
Strategic Planning Workshop (SPW)	A community-based health risk reduction plan is written	Community skills and ability workshop	O2C3 planning method with facilitator focused on objectives	Two strategic-level PPPs, each in Spanish and English	Community members demonstrate that they are able to write a strategic-level disaster reduction plan through consensus
Modified Tabletop Exercise (TTX)	A TTX is performed	Exercise management	Scenario-based TTXs related to all 12 capabilities of the PPP	One TTX after-action report to include both exercises	Community members demonstrate that they are able to participate in a community-based disaster reduction exercise and an after-action report is available to guide the tactical planning workshop
Tactical Planning Workshop (TPW)	A community-based health risk reduction plan is written	Community skills and ability workshop	O2C3 planning method with facilitator	Two tactical-level PPPs, each in Spanish and English	Community members demonstrate that they are able to write a tactical-level disaster reduction plan through consensus and a tactical-level disaster risk reduction plan is available to guide community decisions
Project Evaluation	The intervention is evaluated for effectiveness in terms of implementation, outputs, and outcomes	Data collection and analysis	Intervention effectiveness study including: ○ review of operational data ○ focus group interviews ○ survey of participant knowledge/attitudes/beliefs	Final project evaluation report	The intervention is usable in terms of measures of: ○ Effectiveness ○ Efficiency ○ Satisfaction ○ Engagement And a study of intervention effectiveness is available to guide future interventions
Communicating Progress	Project progress is communicated	Outreach	Community engagement to include email, telephone calls, and face-to-face visits	Roster of participants according to organization and survey of participant knowledge/attitudes/beliefs	Community members have a good understanding of the project and community members support the project

Table 2. Logic Model for "Plan to Protect" Pilot Project
Abbreviations: PPP, population protection plan; O2C3, Operational, Objective-based, Consensus-based, Capability-based, Compliant; TTX, tabletop exercise.

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Measures of Adequate Usability	Effectiveness	Efficiency	Satisfaction	Community Engagement
Definition	Successful in producing the intended outcomes	Successful in using the least amount of input to achieve the highest amount of output	Successful in imparting positive attitudes and emotions among participants	Successful in engaging participation among community members
Indicators for Project Implementation	Completeness: % of project objectives and activities completed Knowledge: Likert score of participants regarding their understanding of the project	Outputs/time: % of on-time completions for project objectives and activities Outputs and outcomes per time investment	Attitudes: Mean Likert score of participant attitudes regarding their support of the project Focus group discussions among implementing partners	Degree of engagement: Focus group discussions among implementing partners regarding degree of engagement
Indicators for Risk Communication Meeting (RCM)	Knowledge: Likert score of participants regarding their awareness of the hurricane-related health hazards in their community	Outputs/time: % on-time completion of the presentation	Attitudes: Mean Likert score of participant attitudes regarding: ○ Relevance of the information ○ Their support of the project ○ Clarity of the presentation ○ Inclusiveness in the meeting	Degree of engagement: % of community participation % of agency participation # of key participants not participating Focus group discussions among participants regarding degree of engagement
Indicators for Strategic Planning Workshop (SPW)	Completeness: % of plan objectives written Mean Likert score of participants regarding their ability to write a (strategic-level) disaster reduction plan by community consensus	Outputs/time: # plan objectives written per hour	Attitudes: Likert score of participant beliefs regarding ease of their understanding Mean Likert score of participant attitudes regarding clarity of presentations Mean Likert score of participant attitudes regarding receptiveness to their opinions Focus group discussions among participants	Degree of engagement: % of community participation % of agency participation # of key participants not participating Focus group discussions among participants regarding degree of engagement
Indicators for Tabletop Exercise (TTX)	Completeness: % of plan activities written; % of plan activities with responsibilities identified Completeness: Mean score estimating tactical level of detail (0-4) for each plan activity Knowledge, skills, abilities: Likert score of participants regarding their ability to participate in a (tactical-level) community-based disaster reduction exercise	Outputs/time: # plan objectives written per hour	Attitudes: Likert score of participants attitudes regarding their ease of understanding Likert score of participant attitudes regarding clarity of presentations Likert score of participant attitudes regarding receptiveness to their opinions Focus group discussions among participants	Degree of engagement: % of community participation % of agency participation # of key participants not participating Focus group discussions among participants regarding degree of engagement
Indicators for Tactical Planning Workshop (TPW)	Completeness: % of plan activities written; % of plan activities with responsibilities identified Completeness: Mean score estimating tactical level of detail (0-4) for each plan activity Knowledge, skills, abilities: Likert score of participants regarding their ability to write a (tactical-level) disaster reduction plan by community consensus	Outputs/time: # plan activities written per hour	Attitudes: Likert score of participant attitudes regarding their ease of understanding Likert score of participant attitudes regarding clarity of presentations Likert score of participant attitudes regarding receptiveness to their opinions Focus group discussions among participants	Degree of engagement: % of participation by community % of participation by agency # of key participants not participating Focus group discussions among participants regarding degree of engagement

Table 3. Indicators Used for Measuring Intervention Usability, in Terms of Effectiveness, Efficiency, Satisfaction, and Community Engagement

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Measure	Community A			Community B		
	SPW	TTX	TPW	SPW	TTX	TPW
Number of objectives or activities in the population protection plan	77 objectives	172 activities	144 activities	79 objectives	153 activities	148 activities
Number of plan objectives or activities completed during workshop	77 objectives	148 activities	144 activities	79 objectives	124 activities	148 activities
Percentage of plan objectives or activities completed	100%	86%	100%	100%	81%	100%
Duration of workshop (in hours)	5.5	4	5	5.5	4	5
Strategic rate (# of plan objectives/hour)	14.0			14.4		
Tactical rate (# of plan activities/hour)		37	28.8		31	29.6
Reviewers mean score of tactical-level detail (1-4)		2.51 (CI, 2.40-2.61)	3.56 (CI, 3.51-3.59)		2.50 (CI, 2.38-2.61)	3.59 (CI, 3.54-3.63)
Percentage of plan activities with no assignment of tactical-level responsibility		78%	0%		80%	0%

Table 4. Outputs and Outcomes of the Six Project Workshops that Performed Planning
Abbreviations: SPW, Strategic Planning Workshop; TPW, Tactical Planning Workshop; TTX, tabletop exercise.

Statement	No Answer	Disagree	Neutral	Agree
The workshop shared a general description of the health risk assessment related to the disaster for the municipality.	0%	0%	0%	100%
Community members showed that they are aware of the health hazards in their community, related to hurricanes.	0%	3%	3%	94%
Community members demonstrated that they are able to write a health risk reduction plan.	0%	6%	0%	94%
Community members demonstrated the ability to participate in a community-based disaster reduction exercise.	0%	2%	6%	92%
Community members demonstrated that they are able to implement a health risk reduction plan with community consensus.	0%	2%	18%	80%
This content is relevant to my work or community work.	0%	1%	0%	99%
This content is relevant to my family.	2%	1%	5%	92%
The material was presented clearly.	0%	1%	2%	97%
The material was easy to understand.	1%	1%	4%	94%
The exercise was well organized.	0%	1%	1%	98%
I felt that my comment and opinion was welcome.	2%	1%	3%	94%
I have a good understanding of this project.	3%	1%	2%	93%
In general, I support this project.	2%	1%	1%	96%

Table 5. Percentage of Participant Agreement Using Likert Scales to Assess Qualitative Statements about the Four Community Convenings

	May		June		August		October	
	Risk Communication Meeting		Strategic Planning Workshop		Tabletop Exercise		Tactical Planning Workshop	
	A	B	A	B	A	B	A	B
Invited (#)	56	43	52	51	66	57	53	54
Attended (#)	28 (50%)	30 (70%)	23 (44%)	30 (59%)	50 (76%)	45 (79%)	35 (66%)	35 (65%)
% Federal	11%	3%	17%	20%	6%	16%	6%	20%
% Territorial	46%	53%	39%	27%	36%	47%	31%	46%
% Municipal	0%	10%	4%	0%	26%	13%	26%	11%
% NGO	29%	20%	35%	33%	16%	13%	17%	9%
% Individuals of the Community	14%	13%	4%	20%	16%	11%	20%	14%

Table 6. Participation in Workshops (A and B), According to Stakeholder Type
Abbreviation: NGO, nongovernmental organization.