

The Power and the Promise: Working With Communities to Analyze Data, Interpret Findings, and Get to Outcomes

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Although the intent of community-based participatory research (CBPR) is to include community voices in all phases of a research initiative, community partners appear less frequently engaged in data analysis and interpretation than in other research phases. Using 4 brief case studies, each with a different data collection methodology, we provide examples of how community members participated in data analysis, interpretation, or both, thereby strengthening community capacity and providing unique insight. The roles and skills of the community and academic partners were different from but complementary to each other. We suggest that including community partners in data analysis and interpretation, while lengthening project time, enriches insights and findings and consequently should be a focus of the next generation of CBPR initiatives. (*Am J Public Health*. 2008;98:1407–1417. doi:10.2105/AJPH.2007.113571)

In 2001, the Agency for Health Care Research and Quality commissioned a systematic review of published work describing community-based participatory research (CBPR) approaches to improving health. From this review, CBPR was defined as follows:

A collaborative research approach that is designed to ensure and establish structures for participation by communities affected by the issue being studied, representatives of organizations, and researchers in all aspects of the research process to improve health and well-being through taking action, including social change.¹⁽³⁾

As reported in the 60 studies reviewed, community involvement extended through all areas of research, and many study authors argued that the involvement of community partners encouraged greater participation rates, strengthened external validity, decreased loss to follow-up, and increased individual and community capacity.¹ These positive attributes notwithstanding, the strongest and most common engagement occurred in recruiting study participants and designing and implementing the research and interventions; less common was community participation in data analysis and interpretation of findings.

It is unclear whether community partner involvement in these phases of research has simply been reported less frequently in peer-reviewed publications or whether community

partners have actually been less engaged in data analysis and interpretation. It has been suggested that diverting community expertise, time, and attention to acquiring analytic skills, both quantitative and qualitative, may be misplaced, particularly when balanced against the (1) efficiencies of drawing on analytic skills and resources that academic partners bring to the research enterprise and (2) priorities focused on enhancing existing community expertise.² It also has been asserted that both the community and academic partners for a single study could be overwhelmed by the commitment of time and resources necessary to prepare for equitable engagement in all phases of the research, especially data analysis and interpretation.^{3,4} Some community partners have argued that their involvement—particularly in data analysis—is not always the best use of their time.

Nevertheless, most academic partners engaged in CBPR stress the fundamental value of the community–academic partnership deciding on specific roles and responsibilities. Although these may be fluid as they adjust to a project's unique needs, the critical role of community partners in interpreting and synthesizing findings—even if they are not involved fully in data analysis—remains a hallmark of CBPR. Through the participatory process of jointly interpreting data, differing

perspectives are articulated and integrated, thereby enriching insights and discoveries.^{5–7}

With little empirical evidence on the implications of engaging community partners in data analysis, interpretation, or both, we are at the beginning stages of understanding the benefits and challenges of bringing them into these phases of research. We may find that working in partnership on data analysis and interpretation could require skills—still to be articulated fully—from community partners that are different from but complementary to those of the academic partners, thereby increasing the credibility of outcomes and likelihood for translation into practice.

We present 4 case studies from our own CBPR studies. The cases represent a range of methods for data analysis or interpretation of findings. We (1) review the collaborative processes used; (2) identify challenges met in data analysis, interpretation of findings, or both, and the impact each partnership had; (3) discuss how community–academic collaboration added value to the analytic and interpretive phases of research; and (4) highlight lessons learned across the 4 cases.

The first case is a partnership between faculty and students from the University of New Mexico, the Albuquerque Area Indian Health Board, and members of a nearby tribal community. This partnership was forged to assess the tribe's public health infrastructure and capacity to improve health. Participants used mixed qualitative and quantitative analytic methods. The second case is a partnership carried out in Detroit's east side involving participants from community-based organizations, the local health department, an integrated care system, and faculty, students, and staff from the University of Michigan School of Public Health. In it, community partners interpreted results from a community survey aimed at examining and addressing social determinants of health.

The third case, a partnership between a North Carolina Latino men's soccer league, other community-based organizations, and faculty at the University of North Carolina's School of Public Health, used focus group methodology to understand issues related to sexually transmitted infections, particularly HIV. In the final case, a partnership between neighborhood organizations in Brooklyn in New York City and faculty from Hunter College, Queens College, and City University of New York used mapping as a methodology for documenting environmental health. Table 1 presents a summary of these cases, with the challenges faced by the partnerships and the impacts the projects had.

CASE STUDIES

Building Public Health Infrastructure and Assessing Capacity in a Tribal Community

The Tribal Core Capacity Program is a CBPR partnership between the Albuquerque Area Indian Health Board (AAIHB), the University of New Mexico Masters in Public Health Program, and local tribes. Funded in 2000 by the Centers for Disease Control and Prevention (CDC), the program had 2 aims: to develop tribes' capacity to address their own health issues⁸ and to increase detection of breast and cervical cancer to reduce disparities in cancer mortality rates.⁹ For this case study, the partnering tribe was Ramah Navajo, a semiautonomous tribal band with 3900 members, 2.5 hours from Albuquerque, New Mexico's main urban center. Project leadership was provided by the Ramah Navajo School Board, an elected body responsible for health and education. The Ramah Navajo Tribal Chapter, with elected delegates to the Navajo Nation Tribal Council, assumed responsibility for other tribal functions.

The University of New Mexico proposed that the Ramah Navajo School Board use the CDC's Local Public Health System Performance Assessment (LPHSPA) instrument to assess the tribe's capacity to perform the 10 essential public health services.¹⁰ To represent the local public health system, the Ramah Navajo community developed a diverse advisory committee of providers and community members, which was supported

by the director of the Ramah Navajo Health and Human Services Department. This committee had a steady core of 6 to 8 health staff and a school board member (representing tribal leadership). In addition, an ad hoc group of 6 to 8 representatives from the schools, Head Start, police, the Ramah Navajo Tribal Chapter, and other sectors regularly attended advisory committee meetings. Tribal community elders, who were members of the advisory committee, attended less regularly. University faculty and staff provided core public health trainings and visioning processes to prepare the advisory committee to apply the LPHSPA instrument.

The assessment itself required 4 meetings, stretched over a 2-month period, with individuals from various tribal programs participating. Each meeting had an average of 15 attendees. The advisory committee found that the instrument used too much professional jargon and included too little tribal information for their purposes. The University of New Mexico and the AAIHB therefore created worksheets to explain the results of the LPHSPA assessment. For each item on the LPHSPA instrument, the university reported the results of the advisory committee's assessment at a meeting and then documented the ensuing discussion about how closely tribal programs met each essential service's national standards and how well they served the tribe. Although the Ramah Navajo is a small community, the local providers of social services and health programs realized that they were learning for the first time about the opportunities and challenges faced by the different tribal programs.

Participatory data analysis and interpretation of findings. Participatory data analysis occurred during regularly scheduled advisory committee meetings, and at an all-day priority-setting session with advisory committee members and leadership from both the Ramah Navajo School Board and the Tribal Chapter. In addition to analyzing the quantitative LPHSPA data summarized on worksheets, meeting participants examined the qualitative data, which the university had organized by strengths and challenges faced within each essential service.

At the all-day meeting, bar graphs of priority scores and the summary of qualitative

strengths and challenges provided the basis for synthesizing the findings and applying them to action planning. An external facilitator led the discussion of each essential service's ranking and wrote down on newsprint paper the core lessons learned from the assessment process. A consensus process—that is, informal, extended discussion in which core lessons were grouped until people reached consensus—led to the selection of 4 priority actions. Under the rubric of the new community partnership, 2 actions were launched immediately: a committee to develop a single community profile instrument to unify disparate program assessments and a committee to produce a culturally appropriate video on breast and cervical cancer.

The decision to conduct a comprehensive community profile (including items on health, land, water, education, housing, family, community capacity, historical trauma, language, and culture) resulted in an extensive, separate 3-year process. This had input from Ramah Navajo tribal programs, the 2 leadership bodies, tribal elders (in translating the instrument into written Navajo), and the AAIHB and approval from the Navajo Nation institutional review board. By fall 2006, tribal interviewers had collected data from 268 randomly selected households, about one third of the total population. University researchers produced survey response frequencies printed as percentages on a master survey form, as well as visually through pie charts and bar graphs. To elicit further questions for analysis, advisory committee members made presentations to the leadership and the community. As a result, the leadership requested analyses by age, gender, and other correlates to health while contributing to discussions on interpreting responses and dissemination strategies.

Benefits and outcomes. The University of New Mexico adapted the assessment instrument, and tribal members provided culturally appropriate language and insight into the relevance of the findings to their lives. The outcomes included recommendations for further adapting the LPHSPA instrument to extend its usefulness to other tribes, as well as the creation of a bilingual (Navajo–English) community profile. Together, the university, AAIHB, and the Ramah Navajo completed a capacity-building process that integrated

TABLE 1—A Summary of Case Studies of Community-Based Participatory Research (CBPR)

Case	Composition	Structure	Colearning Methodology	Type of Data	Community Partner Role	Academic Partner Role	Time Required to Analyze/Interpret Data	Techniques to Make Data Accessible	Challenges	Impact
Ramah Navajo (New Mexico)	Diverse volunteer advisory board: health staff service providers, educators, elders. Elected tribal school board authorized the project.	Participants were predominantly volunteers, although the director encouraged selected health staff to participate. Decisions were made by consensus, and the structure was informal and fluid, with two thirds of participants coming regularly. This group reported to the Ramah Navajo School Board, which was a formal elected body.	Visioning: guidance in use of assessment and priority setting tools; discussions of meanings contained in analytic results; oppression-tions.	Phase I: quantitative (data analyzed by CDC); phase II: qualitative (survey data).	Collaborated on analysis and interpretation of CDC's LPHSPA instrument; set priorities for action; codeveloped survey instrument content and language; conducted interviews and shaped interpretation.	Led instrument adaptation; developed explanatory worksheets; documented advisory board's quantitative scoring and led qualitative analysis discussions.	4 meetings in a 2-month period; 1 full day for priority setting of LPHSPA. Survey data not reported on.	For LPHSPA, bar graph and ranking of qualitative results; narrative chart summary of strengths and weaknesses from qualitative data; for survey data, pie charts/ graphs.	Time; retaining community partners; need to adapt professional jargon of LPHSPA; need to translate survey into Navajo; maintaining tribal elders' participation.	Local community profile developed and administered; improved cultural competence; modification of federally developed LPHSPA assessment tool; capacity building. ^a
East Side Village Health Worker Partnership (Detroit, Michigan)	Representatives from local health department, CBOs, integrated care system, and academia composed steering committee and local lay health advisors referred to as village health workers or VHWs.	Steering committee met monthly and followed adopted CBPR principles and operating procedures; VHWs met monthly.	Discussed and interpreted data feedback materials and results; identified priorities and action strategies; shared descriptive results; selected research questions.	Quantitative (derived from random-sample household survey).	Defined scope of work; developed conceptual framework; identified key variables; selected/modified measures for questionnaire; interpreted and disseminated data; applied data to guide intervention; reviewed pie charts and bar graphs for wider community distribution.	Facilitated steering committee meetings; provided data; helped revise questionnaire; hired, trained, and supervised interviewers; analyzed data; developed data feedback materials.	Over 6-month period, monthly meetings of steering committee and VHWs and half-day retreat.	Placed frequencies on questionnaire; used pie charts and bar graphs to present results; engaged in experiential learning activities to examine results and set priorities.	Time; determining community and academic partner roles; identifying mechanisms for data sharing.	Neighborhood residents hired and trained to conduct interviews; increased knowledge of community strengths and stressors; enhanced understanding of social determinants of health; network of local lay health advisors instituted; capacity building. ^a

Continued

TABLE 1—Continued

Latino Men (rural North Carolina)	Hispanic soccer league, Latino grocery store, leadership development coalition, farm worker advocacy group, Latino-serving CBOs.	Community-based, health-focused coalition met monthly and followed adopted CBPR principles.	Partner in all phases of data analysis and interpretation.	Qualitative (derived from focus groups).	Set priorities; moderated and hosted focus groups; read transcripts; with academic partners, developed coding system and data dictionary; assigned codes to text; refined and interpreted themes; provided cultural knowledge.	Provided leadership and expertise in data analysis; used Nvivo software (QSR International, Cambridge, MA) to code and retrieve text.	8 months.	Systematic, multistage process; data analysis teams had lay and professional members; flipcharts were used throughout the process for review, revision, and final presentation of approved themes.	Time; racial tensions in larger community reflected in community partners; concern about suitability of topic selected; tension between research process and immediate action.	HIV and STD prevention initiative developed; capacity building. ^a
Greenpoint/Williamsburg (Brooklyn, New York City)	Local students, Latino, Polish immigrant, and Hasidic Jewish community members.	Participants partnered with academic scientists; map making was done by both community members and professionals.	Partner in all phases of data gathering and analysis.	Qualitative and quantitative; mapping; air pollution samples.	Introduced professionals to neighborhood; contributed knowledge of local environmental hazards; produced visuals on map depicting polluters; distributed maps in neighborhood; galvanized community to action.	Provided GIS to help local people map what was important to them; learned from community about existence of specific hazardous locations that professionals routinely overlooked; participated in public action for reduction in pollutants.	6–9 months.	Maps provided “common language” for all participants; visuals allowed the individuals not technically trained to participate in technical data analysis and interpretation.	Time; retaining complexity while simplifying; recognition of maps as provisional products that complement other sources of information; capturing community knowledge in quantitative format.	Neighborhood residents activated; project aim altered to focus on pollution; EPA’s decision regarding pilot community exposure project affected; new pollution prevention programs developed; capacity building. ^a

Note. CDC = Centers for Disease Control and Prevention; LPHSPA = Local Public Health System Performance Assessment; CBO = community-based organization; STD = sexually transmitted disease; GIS = geographic information system; EPA = Environmental Protection Agency.

^aFor discussion of capacity building, see sections on specific case studies in text.

visioning, public health trainings, and the use of multiple tools for assessment and priority setting. Community members gained skills that included adapting and developing instruments for their own use, collaboratively interpreting quantitative data, co-analyzing qualitative data, interviewing, setting priorities, and using community data for planning. In addition, tribal staff gave presentations at tribal and public health conferences.

Anticipated benefits from the community profile assessment include the integration of community voices into tribal health planning and improved communication among programs, leadership, and community members. Perhaps most importantly, inclusion of the community voice resulted in a high level of support for engagement in this type of community-involved program. Without significant community input into interpreting and synthesizing LPHSPA data, the need to strengthen synergism among programs—particularly the desire to adopt a single community assessment instrument—would not have been identified.

Developing The East Side Village Health Worker Partnership

The East Side Village Health Worker Partnership represents a CBPR effort that involved a lay health adviser intervention to examine and address the social determinants of health on the east side of Detroit, Michigan.^{11–14} The partnership was established in 1995 with funding from the CDC, as an affiliated project of the Detroit Community–Academic Urban Research Center,¹⁵ and was guided by a 12-member steering committee comprising representatives from the local health department, 6 community-based organizations, a managed-care entity, and the University of Michigan School of Public Health. The committee met on a monthly basis. Applying the same criteria used to select members of the board of the Detroit Urban Research Center at the time of the initial grant proposal submission,¹⁵ the steering committee partner organizations were selected on the basis of their history of involvement and credibility in the community, common interest in the health and quality of life of community residents, and prior relationship between the organization and the academic institution or health department involved.^{11–14}

Since CDC funding ended in 2003, the partnership has been a citywide effort based at the local health department. In accordance with CBPR principles the partnership adopted,¹¹ the steering committee guided all aspects of the research and intervention. The project's first 6 months were dedicated to establishing working relationships, operating norms, CBPR principles, and specific objectives that drew on the local knowledge of steering committee members.^{11,12}

The steering committee decided to conduct a random sample survey in the community to assess community needs and assets to guide interventions, gather baseline data to evaluate the impact and outcomes of interventions, and test a stress process model that links stressors and protective factors to enduring health outcomes within the context of Detroit's east side.^{11,16} Through a series of group discussions and in-depth interviews, the steering committee was instrumental in creating the conceptual framework of stress and health, identifying key variables to examine, selecting and modifying measures included in the survey questionnaire, developing procedures for survey administration, interpreting results, applying findings to guide interventions, and disseminating results.^{11,12,16} For example, the committee engaged in a focused group discussion that produced a revised understanding of stress that included numerous stressors and protective factors that the university researchers had not considered; questionnaire items developed to assess these factors were included in the survey.^{13–17}

The committee also made several key decisions, including designating eligibility criteria for who would be surveyed (e.g., women only), delineating intervention area boundaries from which households were randomly selected, and hiring and training neighborhood residents to conduct the interviews.¹² The committee's contributions helped ensure the validity of the questionnaire's content. The ability to generalize to other community settings was not an aim of the survey. With the project focusing on women's health, 700 women were interviewed, for a response rate of 81%.¹⁵

Participatory data analysis and interpretation of findings. Given the time and skills required, the steering committee decided that the survey

data would be analyzed initially by the partners at the University of Michigan School of Public Health and that the steering committee and the local lay health advisors trained by the partnership (called “village health workers”) would be actively engaged in determining the meaning of the results and their implications for action. As the survey was fielded, the intervention component of the partnership was being implemented and the village health workers were selected and trained and began meeting regularly.^{11–14} Over a 6-month period, a series of separate monthly meetings of the steering committee and of village health workers was held, culminating in a half-day retreat in which steering committee members and village health workers collaborated on interpreting results. Approximately 12 steering committee members and 25 village health workers participated in these meetings in which basic descriptive results were discussed and priority areas and potential strategies for addressing them were identified.

Initially, the data were shared by distributing a copy of the survey questionnaire with the number of responses and corresponding percentages for each item inserted (e.g., percentage of respondents experiencing different stressors). At these meetings, committee members and village health workers were asked to discuss several questions, including the following: In reviewing results from the survey, what do you think they mean? What is your interpretation? Are there any surprises, that is, findings that you would not have expected, and if so, how do you make sense of them? To foster further dissemination of the survey results, the committee developed a report of key survey findings that was distributed widely throughout the community. By using bar charts and pie graphs and by reviewing and revising material, the committee produced a report that was accessible and visually appealing.

Subsequently, the university partners conducted correlation analyses between a number of key variables (e.g., stressors and health outcomes) and regression analyses to examine the steering committee's major research questions. In all instances, results were brought to the committee, with the university partners presenting findings and community partners providing their interpretations of the results.

When necessary, university partners provided information on the different statistical methods used and how to read the data presented in tables; no formal workshops or training were necessary, and community members were readily able to make sense of the results through their knowledge of the community. Through a series of meetings, in which experiential learning methods such as nominal group process and Force Field Analysis¹⁷ were used, the committee set priorities and devised strategies for addressing the problems identified in the survey.

Benefits and outcomes. Several benefits were associated with involving all partners in the process of interpreting survey findings. First, the community partners were able to provide an in-depth understanding of the broader community context and how it should shape the meaning of the quantitative results. For example, the academic researchers were surprised by survey results indicating that community members were generally satisfied with their access to health care providers. The community partners explained that the issue of concern within the community was quality of health care, not access per se, which had implications for the selection of appropriate action strategies. Second, they were able to enhance their own understanding of the strengths and limitations of survey data, while the data itself often helped to validate their assessment of what was happening in their community.

Third, the involvement of community partners ensured their input into the translation of strategies to address issues raised in the survey. For example, through the process of setting priorities, the steering committee and village health workers initially decided on 4 priority action areas (i.e., strengthen relations with police precincts, improve physical safety for children, reduce financial vulnerability, and support adults with responsibility for children) that were based not only on the survey results but on their understanding of the neighborhood context.

Improving Latino Men's Health

Since 1991, Chatham Communities in Action (CCIA), a community-based, health-focused coalition in rural central North Carolina, has been conducting health promotion

projects that follow CBPR principles. After its initial successes in African American church-based diabetes prevention and management programs,^{18,19} CCIA expanded its representation from the Latino community through recruitment and voluntary participation. Representatives from several key organizations joined CCIA, including a Latino soccer league of more than 1800 adult Latino men, a farm worker advocacy group, a statewide coalition established to promote Mexican leadership, a local *tienda* (Latino grocer), and a community-based organization serving Latinos.

The expanded CCIA decided to undertake a focus group study to (1) explore sociocultural determinants of sexual risk among non-English-speaking, less-aculturated Latino men living in North Carolina, a state that is experiencing rapidly growing Latino populations and disproportionate HIV and sexually transmitted disease infection rates, and (2) identify potentially effective intervention approaches that would be context sensitive and gender relevant. Together, the partners created, reviewed, revised, and approved a focus group moderator's guide. This process took about one month. CCIA completed 7 focus groups. The league president recruited focus group participants; a CCIA partner served as the focus group moderator and a university researcher proficient in Spanish served as note taker. A Latino-serving community-based organization, one of the new CCIA partners, hosted the focus groups.

Participatory data analysis and interpretation of findings. Using an inductive approach to data analysis,²⁰ the partnership focused its analysis on a wide array of experiences to build an understanding of HIV risk that was grounded in real-world patterns. Participants used a systematic multistage process to analyze and interpret the data. All audio-recorded transcripts of the focus groups were professionally transcribed verbatim and translated into English. A CCIA community partner and an academic partner listened to each tape while reviewing both the Spanish- and English-language transcripts to ensure that the written transcripts correctly reflected the audio-recording. This step included evaluating the translation of the transcripts from Spanish into English to ensure that meaning was not lost.

An ad hoc committee of 9 CCIA members was formed to serve as the data analysis team. Members of this team consisted of between 1 and 3 representatives from each of the following groups: the lay Latino community, the Latino soccer league, a Latino-serving community-based organization, the local health department, an AIDS service organization, and the university. Because some analysis team partners were not bilingual, each read and coded transcripts in his or her own language.

The analysis aimed to identify common themes through coding text. Conducting the analyses separately, analysis team members read and reread the transcripts to identify potential codes, convened to create a common coding system and data dictionary, and then separately assigned agreed-upon codes to relevant text. The academic partner used Nvivo (second edition; QSR International, Cambridge, Massachusetts), an analytic software program, to code and retrieve text. Analysis took about 8 months because of members' other commitments.

Similarities and differences across transcripts were examined and codes and themes revised accordingly. Analysis team members met to compare and revise themes. One theme was the positive role of "traditional" notions of masculinity that are often identified as having negative influences on men's health. Instead, the partnership approach teased out the positive aspects of masculinity, such as respecting oneself and taking care of one's family, which are linked to immigrating to the United States. After they had refined themes, the themes and accompanying interpretations were presented to research partners in both English and Spanish; this permitted verification of validity²¹ and helped ensure high-quality, accurate findings.²²⁻²⁴

The data analysis process was completed by writing draft themes on flipcharts so that representatives from the CCIA partnership could review, discuss, revise, and interpret them during 4 iterative discussions. During each step of the process, information generated was combined with partners' cultural knowledge as well as previous research to inform theme development and derive interpretations. This approach yielded 5 themes, which the partnership subsequently employed.

Benefits and outcomes. This study was successful in large part because of early efforts to develop trust among all partners. Building on early success in establishing the research questions, developing the study design, and creating the focus group moderator's guide,²⁵ partners were engaged and thus willing to participate in subsequent phases. Although conflicts occurred, anticipating and accommodating disagreements led to an improved and more-informed understanding of sexual health among Latino men. As a Latino community partner noted, "What we are doing is comparing what we think and know to what others think and know. We [then] walk away knowing more."

The partnership has used the focus group findings as background data for organizational and agency service grants. It also received funding to support a 3-year quasi-experimental study to develop, implement, evaluate, and revise an intervention to promote sexual health among immigrant Latino men living in rural North Carolina. The intervention was designed to build on results of the CBPR study by bolstering existing community strengths and assets while affirming positive social norms through the maintenance of well-being and healthy relationships.

Tackling Environmental Health Issues in an Urban Community

In the Greenpoint/Williamsburg neighborhood of Brooklyn in New York City, community groups and professionals have engaged in research partnerships and map making to address environmental health disparities. Mapping is increasingly understood as a central component of epidemiological research and a key resource for moving community knowledge from research to action.^{26–32} Less well documented is the role maps and map making can play in organizing community members and their expertise and in reframing academic research to better reflect community needs.

The Greenpoint/Williamsburg neighborhood is a low-income community in which several ethnic groups and polluting industries coexist. Latino, Hasidic Jewish, Polish immigrant, and African American families, along with young White families, live in a neighborhood in which over 35% of residents live

below the poverty line. In less than 5 square miles, the neighborhood houses over 30 waste transfer stations, the city's largest sewage treatment facility, and 17 toxic release inventory sites listed by the US Environmental Protection Agency (EPA).³³

Participatory data analysis and interpretation of findings. A community mapping project began after residents learned that the New York State Department of Environmental Conservation had scheduled a public hearing to review the operating permit of Radiac, a neighborhood low-level radioactive waste transfer and storage facility. In preparation for the hearing, students at El Puente Academy, a high school run by the community-based organization El Puente, organized a group called the Toxic Avengers to research and document existing environmental health burdens. After walking through the neighborhood with professionals and gathering existing environmental and health data, including information from the city's Department of Environmental Protection about facility locations and pollutant emissions as well as census demographics, the students produced a map depicting how they viewed their community.^{34(p256)}

To create a sense of urgency that local pollution was compromising residents' health, the student map used skulls to mark local hazards and a background designed to look like an x-ray. Pictures of local facilities were included on the map to ensure that viewers recognized polluters by sight, not just by name, and each image was accompanied by brief text about the facilities' environmental performance. Maps were placed around the community to alert residents about the upcoming hearing.

The Toxic Avengers' map helped organize over 200 residents to attend the Radiac hearing. The purpose was not necessarily to challenge existing data or how it was being interpreted for policymaking. Instead, El Puente, the community-based organization,³⁵ used the map to argue that facilities should not be reviewed and permitted one at a time; rather, the emphasis should be on assessing the cumulative hazard and the impact on human health of a number of neighborhood polluters. Of equal importance, the map helped organize the first multiethnic

environmental health coalition in the neighborhood, the Community Alliance for the Environment, whose members included 3 organizations—El Puente, the Polish-Slavic Center, and United Jewish Organizations—representing thousands of residents.^{34(p256)}

The Community Alliance for the Environment provided the political support behind a second project aimed at measuring street-level exposures to hazardous air pollutants and volatile organic compounds. In this project, a research partnership was formed among 4 research scientists at Hunter College, City University of New York; El Puente; and The Watchperson Project, a community based-organization established to monitor local pollution. The Watchperson Project was created in 1990 to develop community capacity for monitoring neighborhood environmental health hazards and hold private and public sector polluters accountable.

An early step in this process involved 4 Hunter College scientists meeting with over 20 community members to identify and map local polluting facilities through use of a geographic information system. Since there were potentially hundreds of small polluters in this industrialized neighborhood that were not tracked or monitored by any city, state, or federal agency, the research team organized neighborhood-based staff and volunteers to walk the streets and, with the aid of maps, document the locations of polluting facilities and the type of operation. The community field surveys revealed hundreds of facilities not found in the phone book or in any agency database, including dry cleaners, nail salons, and off-set printers, whose proximity to residential buildings was potentially dangerous. These field survey data were entered into a geographic information system and joined with demographic and other land use data, such as school and day care facility locations.

After reviewing the maps and finding that over 50 residential buildings had a printer, dry cleaner, or nail salon on the ground floor, the research team decided to target air sampling in and around these buildings. The samples revealed elevated concentrations of perchloroethylene, toluene, and xylene outside of homes and elevated concentrations of volatile organic compounds inside apartments

located in buildings with one of the targeted facilities operating on the ground floor. During community meetings in which initial results were shared, residents noted that some of the elevated readings were also along streets they observed to be used illegally by trucks trying to avoid traffic on the Brooklyn Queens Expressway. This suggestion altered the project in a new way, expanding the research effort to include pollutant sampling along streets designated as truck routes and those suspected of being used by trucks illegally.

Map-making provided a mechanism for real-time, collaborative spatial data analysis, with university researchers generating maps while community members continually checked their validity and interpreted results according to their own experience. Maps gave community members and researchers a common medium for communicating technical issues that were sometimes difficult to convey through words. They also provided members of the research team—who spoke only English, Spanish, Polish, or Yiddish—with a common “language” to facilitate interpretation and meaning of results.

Benefits and outcomes. The community mapping efforts helped activists in Brooklyn to convince the EPA to pilot its first community-based community exposure project in the neighborhood.³⁶ According to the EPA’s Office of Policy and Planning, the agency selected Greenpoint/Williamsburg for the project because community members were engaged in assessing multiple hazards in their neighborhood and had uncovered exposures that regulators had overlooked.³⁶ The mapping projects also helped community groups extend their own research capacity. El Puente partnered with a not-for-profit consulting firm, Centro de Investigacion de Enfermedades Tropicales, to design and complete a series of asthma-related health surveys, establish a community health worker program, publish their survey results,³⁷ and direct their own research funded by the National Institute of Environmental Health Sciences.³⁸ The Watchperson Project has continued to use the air-sampling results to educate and enroll local businesses in pollution prevention programs as well as to expand geographic information system mapping and analytic capacity within the community.

LESSONS LEARNED

The box on page 1415 summarizes 8 lessons that both community and academic partners learned from the 4 case studies on involving all partners in data analysis, interpretation of findings, or both, to arrive at outcomes that led to concrete actions. These lessons were discussed and fleshed out during 4 years of designing and offering Learning Institutes for the American Public Health Association based on these 4 cases. In addition, through reviews of project documentation, self-reflection, discussion, and distillation, our emergent lessons attempt to address the following questions on engaging all partners in data analysis, interpretation of findings, or both:

- What are the complementary roles and skills for academic and community partners?
- How can academic and community partners anticipate the time and iterative process required?
- Is engaging all partners in data analysis, interpretation of findings, or both, worth doing and doable?

The lessons underscore the importance of an approach that creates space (1) for both community and university partners to draw on their different, yet complementary, experiences and skills and (2) to determine the respective analytic roles and responsibilities for each of these research phases.³⁹ For example, the New Mexico workshops on visioning end products, the North Carolina practice sessions on coding, and the Detroit procedure for conceptualizing issues were not for community partners to acquire the expertise of university partners. Rather, these workshops, practice sessions, and procedures were attended by community and university partners alike to achieve consensus decisionmaking on how the partnership would address the iterative nature of data analysis, the time required to complete it, conceptualization of key research concepts, and the implications of taking short cuts to adhere to timelines and funding agencies’ expectations.

To sustain community–university engagement, therefore, the research teams for all 4 case studies relied on experiential learning

methods to review summarized data and worked closely with community and university partners to solicit their commitment to the time and iterative process required to engage their respective constituents in arriving at outcomes. Finally, the university partners made time to reassure community members about the benefits of the iterative process and presented intermediate stages of data so participants could see progress.

In addition, a thread that ran throughout the 4 cases was the time and iterative process necessary for achieving common ground and understanding of data analysis and interpretation. University partners endeavored to avoid using jargon, particularly terminology related to data analysis, and to recognize that significant research findings were not a replacement for their community partners’ vision for developing and implementing interventions. In the New York mapping case study, the search for common language challenged the neighborhood residents to translate their knowledge into terms that professional partners could understand and manipulate. In the New Mexico mixed-methods example, interpretation moved in the other direction, with instruments developed by professionals being interpreted and edited so that tribal members could understand and work with them as equal contributors.

CONCLUSIONS

These case studies point to the value of combining academic partners’ expertise in data reduction, through statistical packages or thematic categorization, with community partners’ expertise in increasing face and construct validity through language and cultural insight. (Face validity refers to whether a measure looks reasonable; construct validity encompasses the concept that an instrument measures the construct it is intended to measure.) Delineation of complementary roles and skills can help identify additional analyses and future research questions, ensure that interpretation of the findings has meaning for the local community, or both. Capacity building in research skills can then be encouraged through short-term training (possibly provided by the university partner or a third party) and a long-term “pipeline” for

Lessons Learned From Working With Communities to Analyze Data, Interpret Findings, and Get to Outcomes

What are the complementary roles and skills for academic and community partners?

- *Academic and community partners' respective roles in data analysis or interpretation of findings should be determined collaboratively.* Decisions regarding partners' specific roles and where their energies can be best applied need to be made through open dialogue and consensus. There are times when academic and community partners work collaboratively on data analysis and interpretation of findings. At other times, community partners' roles figure prominently in the data interpretation and not in the analysis phase. In the cases presented here, when research methodology called for collecting quantitative data, trained academics took the first steps in structuring data collection and analysis. Community partners were able to contribute ideas for analyses as well as offer insights into the reality reflected by the raw numbers. In addition, they helped refine questions that the data would explore and then made significant contributions to interpreting and synthesizing results. Community members unaccustomed to working with data were able to interpret results when they were presented as percentages or in graphic form. Their contributions to data interpretation often resulted in shared insights that significantly shaped subsequent interventions.
- *Community partners' roles and skills for data analysis or interpretation can be influenced by their prior experiences in research endeavors.* Contained in the power and the promise of using a community-based participatory research approach is the potential of building community capacity. In some cases, engaging community members in iterative experiences and projects resulted in their becoming sufficiently familiar with research to entertain the idea of gaining formal academic credentials. At a minimum, academic partners were able to build on community members' prior experiences; additionally, experienced community members helped mentor community participants who were new to the process.

How can academic and community partners anticipate the time and iterative process required?

- *Data analysis and interpretation of findings are iterative processes.* The iterative process of analyzing and interpreting data needs to be made explicit. The process is well served if academic partners prepare community partners (who necessarily are less experienced in research) for this iterative process and then provide reminders throughout of how prior efforts are shaping current and future decisions. Although all the academic partners in the cases understood the value of using an iterative process to digest data, the community partners generally needed reassurance that recurring iterations were an accepted part of data analysis and interpretation.
- *Obtaining commitment from community partners reduces analysis fatigue and temptation to take shortcuts.* Although both academic and community partners are often anxious to get to outcomes, retaining community partners' commitment to the data analysis and interpretation processes that precede interventions and outcomes can be particularly challenging. The desire for action over analysis can result in shortcuts that fail to consider important information. As demonstrated by our cases, commitment of community partners can be critical to ensuring that the data analysis and interpretation phases are carried out to completion. The process can be well served by ensuring that partners, who have an understanding of the need for balance in analysis and action, make these issues explicit for all. Simultaneously, they might highlight gains in understanding that will contribute to enhancing the effectiveness of subsequent interventions.
- *Simplifying data can aid understanding but also may obscure complex relationships.* Although it is critical to present data in an easily understandable format for all partners involved, oversimplification of complex relationships should be avoided. When using mapping methodology, for example, it is important to employ consistent reminders of how the aggregation process can obscure complex interactions. This can be done by continually raising questions on what is known and still unknown when interpreting the meaning of mapped data.
- *Time required is lengthened considerably.* There are no shortcuts to including both community and academic partners in data analysis, interpretation, or both. Although equitable involvement lengthens project time considerably, the insights gained from juxtaposing different viewpoints should be viewed as milestone accomplishments along the way to outcomes. Methodologies such as visioning workshops, practice sessions on coding, or mapping often lend themselves to brief intermediate action interventions while, simultaneously, overall research processes continue to be carried out. This duality of research and action can help ensure continued community, academic, and funding partner engagement.

Is engaging all partners in data analysis and interpretation of findings worth doing and doable?

- *Experiential learning approaches are effective in engaging community partners.* Although all adult learners can benefit from experiential learning approaches, each case study highlighted the benefits of community partners interacting with data beyond just hearing and talking about them. By seeing data displayed in a visual format that was easily understood, such as on a map or coded transcript, community partners contributed to discussions that reinforced mutual participation and reflection. Through visioning the application of data during facilitated discussions, community partners were able to incorporate information they saw into the context of their own lives and contribute to decisions regarding an initiative's future direction.
- *Including the community in data analysis or interpretation—or both—can increase authenticity of findings.* Ensuring data validity and accuracy and then communicating findings effectively is a concern that underlies all research. Although each of the cases had concluded that the data were accurate, the Latino soccer league case found that through multiple revisions of the focus group codes, the partners produced and interpreted themes that were more trustworthy representations of the local Latino community than of the coalition itself. Time spent using an analysis and interpretation process that involved multiple steps meant that a wide variety of perspectives would be incorporated; this resulted in findings that reflected the broader community rather than simply those in-

increasing the number of racially and ethnically diverse health researchers with a career commitment to CBPR and the elimination of health disparities.

Given adequate time and with relevant modalities, engaging all partners in data analysis, interpretation of findings, or both, is doable and worth doing. By building on the trust and respect established in the earlier phases of research, CBPR partners are uniquely positioned to take lead roles in data analysis and interpretation of findings. In each of our cases, involving all members of the partnership in data analysis, interpretation, or both strengthened community capacity building and increased community members' ability to understand complex issues that affected their health. Simultaneously, the presence of the community voice expanded the academic researchers' understanding of the issues. With partners contributing unique strengths and sharing responsibility to enhance understanding of a given phenomenon,³⁹ these brief cases demonstrate that there is no one correct approach to incorporating the community voice in data analysis and interpretation.

We have described 4 case studies in which communities and universities formed partnerships to analyze data and interpret findings. The roles and skills of community partners were found to be different from but complementary to those of the academic partners. Moreover, the case examples generated outcomes that informed larger studies or interventions and led to externally funded actions. These observations reaffirm the premise that the issue is not *who* has the requisite knowledge and skills for data analysis and interpretation but rather *how* such knowledge and skills are generated, shared, and applied. The next generation of CBPR studies can benefit from placing continued emphasis on specifying evolving roles and responsibilities for all partners in research. In particular, future work needs to build on the lessons identified here to further facilitate engagement of community partners with university partners in data analysis and interpretation. ■

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Contributors

S.B. Cashman organized and led the initial writing and subsequent revisions of this article. E. Eng conceptualized the framework and contributed to all drafts. Specific authors who led the work and composed the drafts of specific case studies and contributed to revising drafts of the article were as follows: S. Adeky, A. Rafelito and N. Wallerstein (Ramah Navajo case study); A.J. Allen and B.A. Israel (East Side Village Health Worker Partnership case study); J. Montaña and S.D. Rhodes (Latino Men case study); J. Corburn and S. Swanston (Greenpoint/Williamsburg, Brooklyn, New York, case study).

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