Community-Based Participatory Research at Jacksonville, Florida Superfund Ash Site: Toxicology Training to Improve the Knowledge of the Lay Community

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ABSTRACT

Until the late 1960s, Jacksonville, Florida incinerated its solid waste with the resultant ash deposited in landfills or used to fill flood-prone areas. These filled areas were later developed into parks, school sites and residential areas. Lead in soil at these sites was the major toxicant of concern and driver of clean-up actions. During the period of assessment of lead-levels in soil, there were no established lines of communication between the City and residents of affected neighborhoods resulting in mistrust in the community. To address communication issues, a community-based, culturally-sensitive Community Environmental Toxicology Curriculum (CETC) and a short video were developed for community stakeholders to inform them of risks, health effects, remediation processes and preventive measures. Pre- and post-tests were developed to measure knowledge gained from the toxicology training. Learning gains averaged 47% and 24% for the community leaders and residents respectively. Most participants strongly agreed that the community toxicology curriculum was a useful tool for promoting awareness of environmental risks in their community and addressing the gap in trust between residents and agencies involved in site remediation.

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BACKGROUND

Florida Agricultural and Mechanical University (FAMU), Institute of Public Health (IPH) and the Department of Health, Duval County Health Department (DOH-Duval), community leaders and other stakeholders developed a grant submission entitled "Racial and Ethnic Environmental Approaches to Community Health (REEACH)", to address technical and environmental justice issues. One of the goals of this project was to plan, develop, and implement a sustained community-based, culturally sensitive CETC to assist with an explanation of risk, prevention of exposure and remediation process and to empower the community to continue delivering the training. The training session was set up at the Jacksonville Urban League for FAMU, IPH to train community leaders (train-the-trainers). The community leader in-turn presented the information to community residents.

Demographics of Health Zone 1

Duval County is divided into six health zones which differ in terms of demographics, socio-economic factors and health outcomes. Health Zone 1 is inclusive of zip codes 32202, 32204, 32206, 32208, 32209 and 32254 with a total population of 122,280 with 71% African Americans (United States Census for Duval County, 2000; Florida Department of Health Duval County, 2013) with 73% of the total properties built pre-1978 (Duval County Health Department, 2000). Children make up a sizable portion of the population with 29,226 families, 15,675 (12.8 %) children < than 9 years old, 8,427 (7 %) < than 5 years old (United States Census for Duval County, 2000). In addition 43% of the children live in poverty (United States Census for Duval County, 2000, Bureau of Labor Statistics, 2009). Lead levels in children of 10µg/dl or greater was measured in 3% of children (Duval County Health Department, Childhood Lead Prevention Program, 2000). Figure 1 is a map of Health Zone 1.

Figure 1. *Map of ash sites contaminated in Health Zone 1*

Environmental Justice

Environmental justice involves the fair treatment of all people regardless of race, ethnicity, income, national origin, or educational level related to environmental consequences resulting from industrial, municipal, and commercial operations. Significant input from the community, enforcement of environmental laws, regulations, and policies related to the federal, state, local, and tribal programs and policies are important (National Research Council, 1999). In addition, the community takes the leadership as health advocates (Frumkin, 2005). Communities of color are home to 27.8 % of all incinerator ash landfills, and 45.9 % of all inactive municipal incinerators (Faber & Krieg, 2005) and have low income and low property values when compared to the national average (Costner & Thornton, 1990). People of color are disproportionately impacted with the greatest number of polluting facilities (Bullard, Mohai, Saha, & Wright, 2007). The Environmental Protection Agency (EPA) use containment more frequently than permanent treatment in minority communities but used permanent removal more often in white communities (Lavelle & Coyle, 1992). Unfortunately, only 3% of the health budget goes toward population health prevention (Satcher & Higginbotham, 2008) and very little funding goes to environmental impact and how to prevent these exposures.

Community Stressors

Cumulative effects related to social, economic and environmental stressors can intensify disparities (Gordon, 2003). Additional stressors may include poverty, racial discrimination, crime, malnutrition, and substance abuse (Adler & Rehkopf, 2008). There are links to premature mortality (Jerrett, Finkelstein, Brook, Arain, Kanaroglou, Stieb…Sears, 2009). Other stressors in environmental health disparities are related to community level vulnerability and individual vulnerability including residential location, neighborhood resources, community stress, chemical exposure (Gee & Payne-Sturges, 2004) and behavioral factors. Preexisting conditions and biological traits such as age and genetics can increase risk to chemicals or stress in the community (Morello-Fresch, Zuk, Jerrett, Shamasunder, & Kyle, 2011). Co-factors from the Bunker Hill Superfund Site (BHSS) related to excess absorption were socio-economic status, parental education level, home hygiene level, smokers in home, nutritional status, use of locally grown produce, play area cover (grass vs. exposed soil), hours spent outside, pica behavior and child's age (Panhandle Health District, 1986; TerraGraphics, 1987).

Although Chronic diseases such as heart disease, high blood pressure, lung, cancers and diabetes have links to the toxicant at the ash sites, it is difficult to sort out personal and behavior factors (e.g., malnutrition, smoking, exercise) which are contributing factors for these chronic diseases. In the next curriculum update we hope to include more about prevention including personal and behavioral factors.

Community Mistrust

When a Superfund site is first listed, the community members and residents were most concerned with management, remediation, site-specific issues, health effects, and environmental monitoring. Over the next five years there was a shift to exposure assessment and reduction methods and issues related to the site involving the route of exposure and contamination of soil, air or water (Ramirez-Anderson, Lothrop, Wilkinson, Root, Artiola, Klimecki, & Loh, 2015). The community developed mistrust over the years especially related to lack of information and lack of communication. The community was also concerned with methods of remediation and the logic, process and effectiveness of the remediation. The complicated process of remediation, site-specific issues, health effects and environmental monitoring, exposure reduction methods were not in the form for the residents to understand. IPH and DOH-Duval attempted to remedy this by development of a CETC, community outreach and health fairs.

Toxicants of Concern

The remediation was based on lead levels measured in the soil. In addition, there was a large range of lead values detected in the soil. The maximum level of 78,800 ppm was detected at Brown's Dump and is estimated through the Integrated Exposure Uptake Biokinetic Model to result in a blood lead level of 1200 µg/dl which would cause serious lead poisoning and illness (United States, Department of Human Health Services, 1997). Lead levels are increased by 1 to 8 µg/dl for residents living in areas contaminated at 1000 ppm of lead (United States, Department of Human Health Services, 1998). Severe lead poisoning occurs above 55 µg/dl which can result in irreversible encephalopathy (Ellenhorn, 1997).

Lead levels have been detected that is likely to cause adverse health effects in the brain at any level even below 5*µg/dl* (Skerfving & Bergdahl, 2015) and at the maximum level of 1900 ppm will deliver three times the dose (18 µg/dl) that interferes with blood formation leading to anemia or decreased hemoglobin (United States, Department of Health and Human Services, 1997). Especially of concern are the vulnerable populations such as children and pregnant women. A video was developed (http://pharmacy.famu.edu/iph-education-outreach/) from the CETC by REEACH and DOH-Duval to inform families how to prevent exposure to lead by limiting children's play time near or on contaminated soil. Hand to mouth ingestion was identified as primary route of exposure (Rosen, 2003). In addition, the video provided a summary about the Project New Ground and the Environmental Protection Agency's (EPA) remediation process.

The toxicants lead, cadmium and arsenic are the inorganic toxicants and the organic contaminants consist of polycyclic aromatic hydrocarbons (PAHs), which occur in mixtures of over a hundred compounds, chlorinated dibenzo-p-dioxins (PCDDs) with 75 congeners with 22 TCDD isomers and polychlorinated dibenzofurans (PCBs) with 209 possible structural congeners. All the toxicants are typically released in the process of active incineration. After the shutdown of the incinerators in the late 1960, the toxicants are mainly in soil, dust, surface water and shallow ground water. Table 1 lists Health Zone 1 toxicants of concern sampled and evaluated for each site. The Agency for Toxic Substances Disease Registry (ATSDR) provide information and fact sheets on health effects of toxicants in Table 1 at https://www.atsdr.cdc.gov/az/a.html.

Table 1. *Ash sites in Health Zone 1 and contaminants sampled and evaluated*

Ash Sites	**Toxicants evaluated** (toxicants not evaluated)
5th & Cleveland	**Arsenic, lead, Polycyclic Aromatic Hydrocarbons (PAHs), Polychlorinated Dibenzofurans (PCBs)** (Chlorinated Dibenzo-Dioxin (Dioxins))
Brown's Dump	**Arsenic, lead, copper, PCBs, Dioxins**
Forest Street Incinerator	**Lead** (Arsenic, PCBs, Dioxins, PAHs)
Lonnie C. Miller Park	**Copper** (Lead, Arsenic, Dioxins, PAHs, PCBs)

To put in perspective of the added cancer risks for the Jacksonville Superfund Site, the National Cancer Institute reports from 2010-2014 that new cancer cases from all sites in the United States were 445.7 cases per 100,000 (National Cancer Institute, 2017). Cancer estimates for arsenic, PAHs, PCBs and dioxin-like compounds is 0 to 1 case per million for each of the toxicants in soil (United States Department of Health and Human Services, 2000). Cancer estimates for arsenic and PAHs are 0 to 1 cases per 10 million and for each contaminant in water (United States Department of Health and Human Services, 2000).

An EPA Record Decision was signed in fall of 2006 mandating the City of Jacksonville to clean up the ash sites. Remediation called for the removal of ash-related contamination above 400 ppm at a two-foot depth in residential areas and replacing with certified clean soil and restricting use to not allow excavation of soil below two feet. Remedial action began in spring 2010. To compare the BHSS involved the removal of contaminated yard with lead above 1000 ppm in soil and replacing with soil < 350 ppm (approximately 1 foot in the yard and 2 feet in the garden). This reduced household dust demonstrating an effective method to reduce blood lead levels in children (Sheldrake & Stifelman, 2003).

The Jacksonville Ash Superfund sites are inclusive of the Forest Street Incinerator, 5th & Cleveland Incinerator and Brown's Dump. The Forest Street Incinerator and the 5th & Cleveland Incinerator operated as a municipal solid waste incinerator from the 1940s until the late 1960s. Land uses include residential, commercial, recreational, and public services, including the Forest Park Head Start School and the Emmet C. Reed Community Center. Brown's Dump was in use from 1949-1955. In addition, this site consists of the former Mary McLeod Bethune Elementary School, Lonnie C. Miller Park Sr. Park and Moncrief Creek now surrounded by single family homes and multiple family complexes which operated as a landfill to deposit ash from municipal incinerators (United States Environmental Protection Agency Superfund Update Factsheet, 2011).

Jacksonville Ash Site Health Consultation Review

There was concern of exposure to toxicants in soil, surface water, ground water and/or sediments through swimming, eating potentially contaminated fish, shell fish and garden vegetables. The Florida Department of Health (FLDOH) consultations for Agency Toxic Substances Disease Registry (ATSDR) are summarized in Table 2. In general, most levels of lead were above 400 ppm (EPA clean up levels in soil) with maximum levels in soil typically in the 1000-2000 ppm around Moncrief Creek with a peak level in soil of over 5000 ppm (United States, Department of Health and Human Services, 2000). The intervention/recommendation generally included cover with compost and sod, good gardening practices and reducing use of facilities with levels above 400 mg/kg.

Community-Based Participatory Research (CBPR) can be effective in African-American adults (Coughlin & Smith, 2017). CBPR supports the transfer of expertise and empowerment across community and academic partnerships (Jones & Wells, 2007) through designing, delivering and evaluating an intervention/prevention strategy. Community organizations and academic partners can further research capacity through partnerships. Due to the trust that the residents have for the community leaders, we selected this group as our facilitators. A dialogue with community leaders was developed and REEACH provided the CETC and training document, presentation and short video specifically designed for the hazardous waste ash site delivered to the community. As a result the community has expressed appreciation and are optimistic about continued participation and collaboration.

Table 2. *United States Department of Health and Human Services Agency for Toxic Substances Disease Registry health consultations summaries conducted in Health Zone 1*

Health Consultation	Toxicants of Public Health Concern	Interventions/Recommendations
1. U.S. D.H.H.S., ATSDR, 5th& Cleveland Street Incinerator, (1996)	Maximum lead level of 3,950 ppm of soil	▪ Cover ash with gravel, compost and grass ▪ Sample for complex organic contaminants and lead 0-3 inches ▪ Lead levels above 400 mg/kg (EPA clean-up residential goal)
2. U.S., D.H.H.S., ATSDR, 5th&Cleveland Street Incinerator, (2003a).	Maximum lead level 4,400 ppm of garden soil	▪ EPA recommends good gardening and food preparation practices ▪ Peak lead levels in collard and mustard greens 0.30 mg/kg greens. ▪ No unacceptable risk of consuming vegetables from soil <500 ppm
3. U.S., D.H.H.S., ATSDR, 5th and Cleveland Street Incinerator, (2003b).	Samples >400 ppm of lead in three locations around the baseball field	ATSDR recommends that the prohibition of organized sports at Emmett Reed Park until a permanent exposure control measures are implemented
4. U.S., D.H.H.S., ATSDR, Brown's Dump, (1997).	Maximum lead level 78,800 ppm, 45% of 103 samples > than 500 ppm, > 5,000 around Moncrief Creek	▪ Remove 6" of soil around basketball court, playground area, and between two southern Bethune Elementary buildings. ▪ Installed fence around parking lot in front Bethune elementary, lock gate in back of school ▪ Restrict access to Moncrief Creek, post signs, repair fence 194 children screened for lead at

		Pre-K, elementary, Bessie Circle, Moncrief Village and Palm Terrace. (4.1%> 10 µg/dl)
5. U.S. D.H.H.S., ATSDR, Brown's Dump, (1999).	Residential 2% ≥ 2,000 ppm, 30% ≥ 400 ppm, Basketball court peak 1,900 ppm with 5 other samples < 400 ppm, Head Start < 400 ppm, Butterfly Park 400-540 ppm	▪ Cover area that exceed 400ppm with mulch, soil or sod ▪ Additional sampling recommended for lead ▪ Limit children's exposure in areas > than 400 ppm Offer blood lead testing for children > than 400 ppm
6. U.S., D.H.H.S, ATSDR, Forest Street Incinerator, (1997).	Maximum lead level 2,930 ppm of soil and all other metals below ATSDR Soil Comparison Values and Low levels of lead and chromium detected in shallow ground water	▪ Restrict access ▪ Sample site surface soil for complex organic chemicals ▪ Test vegetables grown in contaminated soil ▪ 178 children screened for lead at Head Start School
7. U.S., D.H.H.S., ATSDR, Lonnie C. Miller Park, (1999).	Elevated levels of arsenic, lead, copper were detected, Elevated organic toxicants above background.	▪ Additional surface soil sampling ▪ New sampling data to reflect current site conditions ▪ Sampling sites where children play ▪ Levels detected not likely to cause acute or chronic health effects

METHODS

The CETC was developed using a six-step approach developed by Kern, Thomas, Howard, and Bass (1998). This included: problem identification, needs assessment, goals and objectives, educational strategies, implementation, evaluation and feedback. Protocols were reviewed by FAMU Human Subjects Institutional Review Board.

A participatory action research design was applied to this study to include a pre-test and post-test which measured the learning gains, knowledge and attitudes of the community and resident trainees. FAMU, IPH faculty preformed the training in the summer of 2011 at the Jacksonville Urban League to four community leaders. One community leader then conducted the training to 10 community residents.

Given the small sample size, statistical analysis using the Wilcoxon Signed-Rank test for paired observations was employed. The Signed Rank test is a non-parametric procedure that does not require any distributional assumptions to be statistically robust. It is comparable to the paired-sample t-test when these distributional assumptions can be made. Analysis was conducted using SAS© version 9.2.

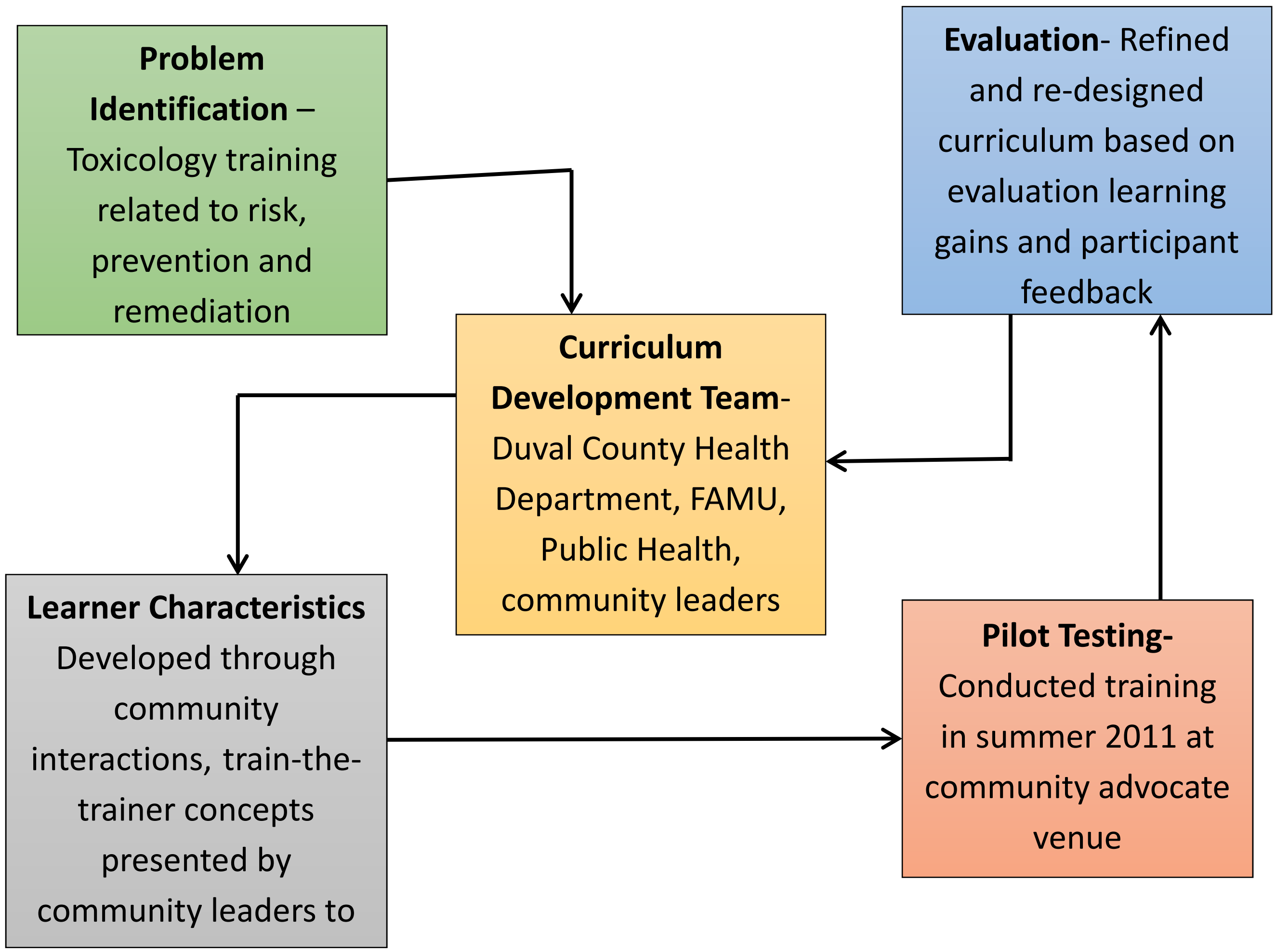
In addition, a community satisfaction survey was conducted to evaluate the training for use in improving the curriculum. The evaluation section contained the Likert-scale with choices of strongly agree, agree, neutral, disagree and strongly disagree. An open-ended comment section was also included in order to give the community an opportunity to comment about the curriculum.

RESULTS

Figure 2 diagrams how the curriculum was developed by opening a dialogue with the community leaders and lay community's concern with contamination in their community.

The **Problem Identification** involved the risk of toxicants in the Jacksonville ash site and to construct a CETC to identify the risk, prevent the exposure and discuss the remediation. The **Curriculum Development Team** which included FAMU, IPH, DOH-DUVAL and the community developed a toxicology curriculum. The **Learner Characteristics** of the community leaders and residents and their needs were developed through community interactions and train-the-trainer concepts where community leaders were trained by IPH faculty to train the residents. **Pilot Testing** was scheduled and conducted in summer of 2011. This process involved securing a community advocate venue (Jacksonville Urban League) and promoting to the community before delivering the product as a pilot. We also provided an extensive question and answer session for the residents. **Community survey, feedback, evaluation and learning gains** were collected from the participants and recommendations are currently being reviewed by the curriculum development team for possible changes to the curriculum. After this process the toxicology curriculum will be returned to the community.

Figure 2. *Community curriculum development outreach and education*



Organization of the Community Environmental Toxicology Curriculum

The CETC two modules and five appendixes. Module 1 reviews key toxicology terms and concepts, Module 2 discusses human exposure, environmental pathways and risk assessment and remediation. REEACH Toxicology Curriculum used a similar format to the toxicology curriculum developed by IPH faculty for ATSDR entitled "A Toxicology Curriculum for Communities Trainer's Manual." It is located on the following link: https://www.atsdr.cdc.gov/training/toxmanual/modules/1/outline.html. The format for the REACH Toxicology Curriculum is similar but more tailored to the Jacksonville Superfund Ash Site. Appendix 1 contains a review of each waste site. Appendix 2 contains a summary of public health concerns. Appendix 3 contains Federal, State and Local Agencies, contact information and what their defined roles. Appendix 4 contains research and community organizations working in REEACH. Appendix 5 contains abbreviated fact sheets on toxicants of concern.

Questions on the Pre-test and Post-test

There were two modules with 11 mixed questions including true and false, multiple choice and short answers. There was a "Test Your Knowledge" crossword puzzle with six additional questions.

Table 3. *Questions and format of the pre-test and post-test*

Learning Gains and the Evaluation

Questions (Module 1)
1. The term toxicant is used when talking about toxic substances that are produced by or are a by-product of man-made activities. T/F
2. Contact with contaminants such as lead and arsenic is <u>not</u> a public health concern for the Jacksonville Ash Site areas. T/F
3. Chronic toxicity is classified as an exposure to a chemical or other substance over an extended period of time. T/F
4. The larger the amount of exposure and the greater the dose of a substance, the greater the observed response or effect on an organism. T/F
5. Which of these groups is usually designated as one of the most vulnerable for exposures to toxic substances? Multiple Choice
6. Children can be vulnerable to lead exposure because they... Multiple Choice
Questions (Module 2)
7. An exposure pathway includes which of the following? Multiple Choice
8. What are at least four of the most likely ways residents can be exposed to contamination in the Jacksonville Ash Site? List
9. Risk assessment includes all of the following: Multiple Choice
10. What is the greatest environmental risk to exposure to **<u>lead</u>** related to the Jacksonville ash sites? Multiple Choice
11. Removing at least 2 feet of soil and replacing it with non-contaminated soil planted with grass can reduce exposure and risk. T/F
Test Your Knowledge (Crossword)
1. What group is most vulnerable to lead exposure? Hint: Young people (1 Across)?
2. What term is used to describe long term exposure? Hint: Opposite of acute (5 Across)?
3. What is the acronym of the agency responsible for funding of the ash cleanup in Jacksonville? Hint: 3 letters (6 Across)?
4. What heavy metal is most widespread and prevalent at the Jacksonville ash sites? Hint: Greatest effect on young children (1 Down)?
5. What term is used to describe the poisonous or deadly effects of a chemical on the body? Hint: Starts with T and ends with C (1 Down)?
6. What term is used to describe short term exposure? Hint: Opposite of chronic (4 Down)?

Most participants strongly agreed that the CETC is a useful tool for promoting awareness of potential environmental risks in their community. Based on the pre-/post-test, there was a 24% average learning gain for the "train-the-trainer" session and a 47% average learning gain for the community resident training session.

The scores for the **Community Leaders'** pre-test for core knowledge ranged from 35-85 (out of 100) with an average score of 64. The post-test scores ranged from 20-97, with an average score of 75. Learning gain scores were also computed for the Community training participants by dividing the actual gain by the potential gain the participants could have possibly scored: (*Post-assessment – Pre-assessment)/(*100 – *Pre-assessment*).

The scores for the **Community Participants'** pre-test for core knowledge ranged from 41-100 (out of 100) with an average score of 64. The post-test scores ranged from 20-97, with an average score of 72. Learning gain scores were also computed for the community training participants by dividing the actual gain by the potential gain the participants could have possibly scored: (*Post-assessment – Pre-assessment)/(*100 – *Pre-assessment*).

Table 6 shows the calculations used to complete the test. We first calculated the difference between pre- and post-test measurements for each participant. Then, the absolute values of these differences were ranked from smallest to largest substituting the average rank whenever differences were tied. One observation showed no change, and therefore, was removed from the test procedure. The two columns under "Signed Ranks" represent the rank of each difference multiplied by the sign of that difference. To complete the Wilcoxon Signed Rank test, let T represent the sum of the smallest Signed Ranks independent of sign. The sum of the ranks of the positive differences is 69 while the sum of the ranks of the negative differences is -22. As such, the Wilcoxon Signed Rank test statistic is given by: $Z_T = \frac{22-\mu_T}{\sigma_T}$ where $\mu_T = \frac{13*14}{4}$ and $\sigma_T = \sqrt{\frac{13*14*27}{24}}$. Under the null hypothesis, Z_T follows a standard normal distribution. In this instance, the Wilcoxon Signed Rank test statistic is equal to -1.64231, which represents a p-value of approximately .051. As such, we can conclude that there is evidence of a statistically significant difference between the pre- and post-test measurements of the participants at the α=.1 level. Most of the differences are positive, suggesting that there is evidence that the training has improved test scores among the participants.

The desired outcome of the REEACH, CETC is to inform and educate lay community about the link between environmental exposures and human health in the north and urban core areas of Jacksonville, Florida. A participant satisfaction survey was conducted following the training and the summary of the evaluation (Table 7). The reaction to training were positive with comments that the training was life living experience, very helpful, examples helpful, very well done, colorful printed presentation, good for people working in the community, great training concept for community. Some suggestions included a one-page brochure, make it more basic, quick review at the end of each module, create on-line hotline/website, bioaccumulation slide was missing from the printed document.

Table 4. *Learning gain for community leaders*

Pretest	Posttest	Post-Pre	100-Pre	Individual Gain
83	97	14	17	.82
35	20	-15	65	-.23
53	91	38	47	.81
85	92	7	15	.47
Average learning gain for the group = .47				

Table 5. *Learning gain for community participants*

Pretest	Posttest	Post-Pre	100-Pre	Individual Gain
62	56	-6	38	-.16
90	97	7	10	.70
59	97	38	41	.93
97	97	0	3	.00
89	82	-7	11	-.64
89	88	-1	11	-.09
100	94	-6	0	.00
41	94	53	59	.90
53	82	29	47	.62
41	47	6	59	.10
Average learning gain for the group = .24				

Table 6. *Statistically significant difference between the pre- and post-test measurements of the participants at the α=.1 level*

Subject	Pre-test	Post-test	Difference (Post-Pre)	Rank	Signed Rank	
1	83	97	14	8	8	
2	35	20	-15	9		-9
3	53	91	38	11.5	11.5	
4	85	92	7	6	6	
5	62	56	-6	3		-3
6	90	97	7	6	6	
7	59	97	38	11.5	11.5	
8	89	82	-7	6		-6
9	89	88	-1	1		-1
10	100	94	-6	3		-3
11	41	94	53	13	13	
12	53	82	29	10	10	
13	41	47	6	3	3	
					Sum = 69	**Sum = -22**

Table 7. *Community toxicology training survey*

Questions	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The Community Toxicology Curriculum is a useful tool for promoting awareness of potential environmental risks in our community.	13 (81%)	3 (18%)	-	-	-
The written materials that I received were useful for guiding me through my own training session.	13 (81%)	3 (18%)	-	-	-
The training prepared me to lead a discussion group on potential environmental risks in our community.	11 (68%)	4 (25%)	1 (6.3%)	-	-
The training included a clear explanation of what is expected of me as a Community Trainer.	13 (81%)	3 (18%)	-	-	-
The training was well-organized and time was used efficiently.	14 (87%)	1 (6%)	1 (6%)	-	-
The facilitator's used clear, simple language that I could understand.	14 (87%)	1 (6%)	1 (6%)	-	-
The length of the training was appropriate for the amount of material that was presented.	11 (68%)	4 (25%)	1 (6%)	-	-
There was enough time to ask questions.	12 (75%)	3 (18%)	1 (6%)	-	-
There was enough variety in the training format (e.g., presentations, discussions) to keep my interest.	9 (56%)	6 (37%)	1 (6%)	-	-
The people who trained me were knowledgeable and able to effectively explain important information.	14 (87%)	2 (12%)	-	-	-
The training was implemented in a culturally sensitive manner.	13 (81%)	2 (12%)	1 (6%)	-	-
Overall, I feel satisfied with the training that I received.	14 (87%)	2 (12%)	-	-	-

DISCUSSION

Lead levels were measured in 194 children in pre-K and kindergarten and 4.1% were found to be above 10 µ/dl. An additional 178 were tested for lead at the kindergarten. Most levels were 3-7 µg/dl with 2% above 15 µg/dl. None of these children were followed-up to check for lead sources for potential exposure (United States Department Human Health Services, 1997). Approximately 9% of children screened in Duval County have lead levels above 15 µg/dl. The body eliminates lead in blood in 4-5 months (half-life is 28-36 days) so blood levels reflect only recent exposure, not long-term exposure (United States Department Human Health Services, 1998). Surveys are considered a "snapshot in time" of ongoing exposure under specific set of circumstances as a specific point in time (Rosen, 2003). Over 4000 blood lead levels were drawn and tested at BHSS and overall after remediation the blood lead levels dropped 50% (TerraGraphics, 2000; Panhandle Health District, 2001). Thus, additional lead testing and more frequent lead testing at the Jacksonville ash sites is warranted. In addition, promoting physicians to do more in-office blood lead levels would be beneficial.

A community-wide approach to clean-up and prevention is an important tool to reduce lead exposure and house dust. Homes cleaned in 1991 at BHSS were re-contaminated within a year (CH2MLHill, 1991). It is estimated that 60%-80% of lead in home originates from exterior soils (TerraGraphics, 2000). Lead exposure is estimated to account for 40% due to dust, 30% community soil, 30 neighborhood including yard (TerraGraphics, 2000). This dust exposure indoors includes interior lead-based paint (Lanphear & Roghmann, 1997). In addition, household hygiene, number of adults living in household and the number of hours a child plays outside contributes to blood lead levels (von Lindern, Spalinger, Bero, Petrosyan, & Braun, 2003).

The Lead Health Intervention Program was established at the BHSS, which seeks to reduce lead exposure by modification of behavior by educating parents and children by improving hygiene was developed at the BHSS. The program includes door to door blood lead survey and nursing follow-up, education for local schools, parents and health care providers (TerraGraphics, 2000).

To maintain, including repair, recontamination, flooding, erosion or deposition of contaminated soil am Institutional Controls Program was developed to regulate the long-term stability of the barriers and enforce the property owners' responsibility in maintaining the barrier (Sheldrake & Stifelman, 2003). Drainage improvements and flood control was essential to minimize recontamination (Sheldrake & Stifelman, 2003). Flooding in the BHSS Milo Creek in 1997 uncovered previously capped contamination and recontaminated the areas (TerraGraphics, 2000). This resulted in erosion of the clean barrier, transport of contaminated to previous remediated area (Sheldrake & Stifelman, 2003).

To decontaminate homes, Calgon (or other powdered detergents) coats particulate lead with polyphosphate groups and is effective in removing interior lead followed by using high efficiency vacuum and 24 hours of drying removes 91% of the lead (Milar & Mushak, 1982). The panhandle Health District offered a vacuum cleaner loan program loaned to BHSS residents.

In summary, methods to reduce exposure during and after remediation include:

- Expanding blood lead testing and follow-up high levels above 5 µg /dl for exposure assessment
- Sampling for lead in homes and an evaluation related to source of contamination by environmental health and medical experts
- Expanding training to include curriculum and exposure modification
- Develop an inspection group to monitor barriers and recommend repair
- Improve drainage to prevent recontamination from flooding and erosion
- Promote decontamination of homes through cleaning programs and training

Limitations

The sample size for this pilot was small, and the numbers will increase with the reintroduction of the training and the proposed on-line training. In addition, collecting demographics of the trainees would be helpful when evaluating the learning gains and the individual test takers and questions. In addition, more professional illustrations to demonstrate the concepts of environmental toxicology and additional simplification of the language.

Conclusion

Additional updates to the REEACH, CETC are planned in the near future based on this pilot. The final training materials will be provided to the community leaders electronically to continue using them as tools to train community residents. The updated CETC will be delivered to the community leaders as a living and transferable document.

Through a CBPR framework, it is envisioned that we can continue academic-community collaborative research, reduce exposure, educate and mobilize the community, and increase partnerships with governmental and environmental organizations (William, Terrell, Anderson, & Tumiel-Berhalter, 2016).

Health concerns remain regarding potential exposures of minorities living near hazardous waste sites to toxic substances. Access to health care and health promotion have been a problem in the Jacksonville, Health Zone 1 (Teutsch & Fielding, 2011). Access to care as well as behavioral, social and physical environments should be considered to reduce exposure to toxic substances (Satcher & Higginbotham, 2008) and this will help reduce disparities.

The DOH-Duval community improvement plan would provide the health care centers and community organizations in Health Zone 1 with environmental medicine training and the CETC curriculum, respectively. In addition, the DOH-Duval community improvement plan would include community outreach to improve awareness of health risks associated with environmental exposures. Moreover, it would reduce deficiencies in essential services, improve education, empower the community, and develop a system to link environmental services to the community.

The wider implementation of the curricula would address the needs of the community by increasing access to health services and enhancing communication within the local public health system. The ultimate outcome of the project is to inform, educate and empower the community to better understand environmental public health issues by linking them to health care providers.

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