

# Working with an environmental justice community: Nurse observation, assessment, and intervention

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## Abstract

Environmental justice (EJ) is the concept that all people and communities, regardless of their race and socioeconomic status, are entitled to enjoy an equally clean environment and resources. Communities where residents face environmental injustice and a higher risk of being exposed to environmental hazards due to their race, ethnicity, and socioeconomic status are called EJ communities. The purpose of this manuscript is to provide an example of nurses' involvement in observation, assessment, and intervention of an EJ community using a community-based participatory research (CBPR) model. Utilizing a multistage CBPR approach along with a mixed methods design, the project was carried out in three stages. Within the three stages, we conducted a thorough observation of the community, identified possible environmental issues, and collected health data and drinking water samples. Citizens' complaints included coal ash, failed sewer system, health issues, including kidney disorders and neuropathy. Drinking water samples ( $n = 59$ ) showed lead levels higher than the health limits in 10.4% of samples. We intervened based on our short-term goal, reducing citizens' exposure to lead by education, and our long-term goal, reducing disparities, and exposures. We recommend that nurses increase their knowledge about EJ communities and environmental exposures and their health effects and be advocates for EJ communities.

## KEYWORDS

drinking water, environmental exposure, environmental justice, lead exposure, nursing

## 1 | BACKGROUND

Environmental justice (EJ) is the concept that all people and communities, regardless of their race and socioeconomic status, are entitled to enjoy an equally clean environment and resources.<sup>1</sup> By contrast, environmental injustice is "the inequitable and disproportionately heavy exposure of poor, minority, and disenfranchised populations to toxic chemicals and other environmental hazards"<sup>2(p178)</sup>. Therefore, EJ can be applied to communities where residents face disadvantages and a higher risk of being exposed to environmental hazards due to their race, ethnicity, socioeconomic and/or immigration status, lack of land ownership, geographic isolation, formal education, occupational characteristics, political power, gender, and proximity to industries.<sup>3</sup> These communities are called environmental justice or EJ communities.

Residents of EJ communities are more likely to experience health disparities and environmentally sensitive diseases such as cancer and respiratory diseases.<sup>2-5</sup> In the US, air quality, on average, is better in more affluent areas, while poor communities with African American or Hispanic populations are generally exposed to worse air quality.<sup>3,6</sup> Coal-fired power plants are mostly located in poor and non-White areas,<sup>4</sup> and drinking water is more polluted in poor communities.<sup>7</sup> Furthermore, low-income communities and communities of color suffer from disproportionate exposure to toxic chemicals released by industries in many communities.<sup>8,9</sup>

Within the past 3 years, the authors have been conducting research, advocating for, and working with the people of Uniontown, Alabama, a disadvantaged community. This town is an EJ community, with mostly African American and unemployed population, who live in close proximity to more than four million pounds of coal ash and a

failed sewer system. Coal ash was taken to Arrowhead landfill near Uniontown, Alabama from the massive Kingston coal ash spill in Tennessee in 2008.<sup>10</sup> The failed sewer system has created exposure risks to different parasites, and per citizens' perception exposure to coal ash has increased the prevalence of neuropathies, asthma, and cancer within the past decade. An important component of coal ash is fly ash, which is made up of small particles that may carry heavy metals and be suspended in the air as fugitive dust, with a potential to harm human health. Although the evidence supports the relationship between living next to coal-fired power plants and susceptibility to chronic diseases, such as asthma and cancers, the results are not conclusive.<sup>11-18</sup>

EJ is considered an ethical principle/value and closely related to the principles of human rights: the right to health and nondiscrimination.<sup>3</sup> Nurses, in all roles and specialties, experience ethical challenges. Understanding EJ and health disparities is important in the context of nursing ethics, nursing care, and nursing outcomes. The American Nurses Association (ANA) Code of Ethics calls for all nurses to advocate for human rights and social justice and brings attention to preserving the human rights of vulnerable groups and rectifying social injustice and health disparities.<sup>19</sup> Although some nurses, for example, public health nurses, have been implementing EJ in their practice, there is not much evidence about nursing assessment and intervention in EJ communities. Therefore, the purpose of this manuscript is to provide an example of nurses' involvement in observation, assessment, and intervention of an EJ community using a community-based participatory research (CBPR) model.

## 2 | METHODS

The lead author who serves as the chair of the environmental task force committee of the Alabama State Nurses Association (ASNA), received a call from a community member of Uniontown, Alabama, about the environmental and health issues of citizens in March 2017. After teaming up with the second author, a public health/political science and policy expert, we designed a three-stage CBPR project with a mixed methods design to investigate the environmental polluters, health status, and water contamination in Uniontown, Alabama and advocate for the community. As the key element of CBPR, we handed the ownership of the project and advocacy process to the community members, as our participants, and involved them in community mapping, community meetings, designing the focus group, surveying health status, collecting water samples, reporting back to community members, and advocating for the community. The study was approved by the authors' university's Institutional Review Board.

### 2.1 | Stage 1 (observation): community mapping and meetings

The goal for stage 1 was to make the invisible environmental injustice condition visible through community mapping. Community mapping helped us to determine the environmental hazards around the

selected community and prioritize them.<sup>3</sup> In this stage, we first used Google maps, census data, and EJSCREEN.<sup>20</sup> EJSCREEN is used to calculate the EJ index and identify the demographic characteristics, polluters, pollutants, and health status in Uniontown, Alabama. The EJ index, developed by the Environmental Protection Agency (EPA), shows how environmental and demographic information come together in the same location.<sup>21</sup> We have discussed this tool in more detail later in the measures section. Then we identified five community leaders by placing follow up calls to the community member who had initially contacted the first author. Four meetings were held with the community leaders, ages ranging from 35 to 65, through in person (two sessions) and conference call (two calls) meetings, each for 60 minutes. Conference calls were used when not all community leaders were available on site. The top concerns about environmental issues and the previous interventions were discussed in each meeting. Later, we visited the town twice and conducted a thorough observation of the community by visiting the areas and speaking to the residents. The leaders helped us speak with the citizens and identify the environmental concerns and confirm our findings from EJSCREEN tool. Citizens expressed concerns about several polluters, including coal ash and the safety of their drinking water and surge of neuropathies in the areas, since the coal ash was brought to the area. Based on these observations, we planned to run a health survey and collect water samples and test them for heavy metals, including lead, which might be connected to coal ash and neuropathy. We aimed to include both city and well water samples.

### 2.2 | Stage 2 (assessment): health survey and water sampling

The goal for stage 2 was to engage community members in the project design and process. After meeting with the community leaders, we decided to hold two consecutive focus group sessions in April 2017, during a weekend in a local church (one on Saturday and one on Sunday) for 4 hours each. This time and location were selected per community leaders' suggestion. We were also advised by the leaders to include snacks, dinner, and door prizes for each session. Community leaders agreed to spread the word about the workshops. Twenty-three citizens who lived in Uniontown, Alabama, for more than 15 years, ages 30 to 65, including five community leaders, and had a city or well water source, attended both focus groups. The same attendees participated in both days. During the meetings, we asked attendees four main questions: 1—What are your concerns and experiences with the environmental issues occurring in Uniontown, Alabama? 2—What are the health issues that you think might be related to these environmental issues? 3—Do you know about available state and community resources? 4—What do you need from nurses, in other words, how we can help you?

We distributed a questionnaire to survey the participants' health status at the end of the first focus group session. Thirteen out of 23 participants completed the questionnaire. The investigators suspected that the low survey return was due to the number of illiterate citizens who participated in the sessions. The high illiteracy

rate was not anticipated by the investigators and consequently, there was an insufficient number of trained researchers to interview the attendees who were unable to complete the survey.

After collecting the health questionnaire, we distributed water sampling bottles and instructions to the participants to collect drinking water samples ( $n = 23$ ). To overcome the negative impacts of illiteracy on water sampling, the authors read and explained the instructions to all and asked the participants who could not read to repeat back the instructions. We asked them to bring back the collected water samples the next day when we had our next focus group. More information about water sampling is provided in the measures section.

## 2.3 | Stage 3 (intervention): report back to community and advocacy efforts

Based on the water test results in stage 1, which showed high levels of lead and traces of arsenic in some samples and support from a mini-grant (supported by the National Center for Healthy Housing, Trust for America's Health and the Health Impact Project, a collaboration between the Robert Wood Johnson Foundation and the Pew Charitable Trusts), the goal for stage 3 was to share the findings of the water testing with citizens and take appropriate and feasible actions. Therefore, we held two educational workshops on 2 consecutive days about lead exposure prevention and how to communicate with legislators, in November 2017. The concerning results of the water samples collected in stage 2, which is discussed in the results section, led us to collect more drinking water samples ( $n = 36$ ) in the November workshops. We also identified and connected with Alabama senators, congressional District representatives, and the governor in Alabama.

## 2.4 | Measures

### 2.4.1 | Water laboratory testing

Fifty-nine participants collected water samples from their kitchen faucets' cold water, first thing in the morning, in stages two and three. Two full bottles (250 mL each) were collected from each household using bottles provided by the laboratory. The investigators collected the samples in the morning and shipped them to TestAmerica lab in Atlanta, GA. The samples were shipped separately for each stage. US EPA method 200.8 was used to measure heavy metals, including lead and arsenic in the water samples. This is the standard and reliable method used by laboratories to measure heavy metals in the water. The results were compared to the EPA's action limit of  $15 \mu\text{g/L}$  and health limit of  $5 \mu\text{g/L}$  for lead and the action and health limit of  $10 \mu\text{g/L}$  for arsenic. We repeated water sampling and testing process for those participants with high lead levels for verification. Due to ongoing lawsuits and per citizens' request, the water testing was conducted independent from the EPA and the Alabama Department for Environmental Management (ADEM).

### 2.4.2 | Health survey

A standard health survey tool of the World Health Organization (WHO) was used to collect demographic and health data.<sup>25</sup> We

selected only the demographic and health-related questions from the standard questionnaires, reformulated them for clarity, and asked participants to complete them during the focus group.

### 2.4.3 | EJ index

We used the EJSCREEN tool to calculate the EJ index, which combines environmental and demographic information. The EJ index is calculated as  $\text{EJ index} = (\text{environmental indicator}) \times (\text{demographic index for block group} - \text{demographic index for US}) \times (\text{population count for block group})$ .<sup>20</sup> This formula calculates the EJ index raw value; however, EJSCREEN reports percentile values rather than the raw value to make the results easier to interpret. Most EJSCREEN users will not work directly with EJ index raw values, which can be positive or negative; however, positive raw values for an EJ index will present as higher percentiles and negative raw values will appear as lower percentiles. The EJ index in the EJSCREEN tool is classified in different colors/percentiles, where red (95-100 percentile), orange (90-95 percentile), yellow (80-90), dark gray (70-80), and light gray (60-70) mean that exposure to environmental risk is above national, region, or state levels and need significant attention.<sup>20</sup> There are several environmental indicators to choose for the above formula, we used lead paint, proximity to waste and hazardous chemical facilities, and wastewater discharge as environmental indicators for the above formula. We used block groups in the formula because Uniontown, Alabama, is a small rural town and block groups would better match the size of this town.

We also considered demographic distribution to identify EJ communities using the definition from the Pennsylvania Department of Environmental Protection (PADEP), which identifies EJ areas as areas with 20% or higher poverty rate or a non-White population of 30% or more.<sup>26</sup> There are different definitions for EJ communities in different states, and some states, including Alabama, do not provide public EJ definitions. We used PADEP's definition because of its simplicity. Using this definition and looking at the census data, nurses can easily identify EJ communities around them.

## 2.5 | Data analysis

We transcribed verbatim both focus group sessions. All discussions underwent thematic analysis, which allowed us to recognize repeating themes across the data set.<sup>27</sup> We used six phases of thematic analysis as recommended by Braun and Clarke<sup>28</sup> and coded all transcripts independently and then reviewed them several times to ensure transparency and reliability. The authors discussed the differences in data interpretation and resolved them. For any ambiguity or unresolvable conflicts between two authors, we contacted the participants for clarification.

We used descriptive analysis to describe demographic characteristics, water contaminants, and health status. Out of 59 drinking water samples, seven (12%) and 52 (88%) were well and city water samples, respectively. Due to the lack of normal distribution, a

**TABLE 1** Demographic indicator and EJ index of Uniontown, Alabama in the state of Alabama, EPA region 4, and United States (US)

Demographic <sup>b</sup> Indicators	Definition	DI Percentile <sup>a</sup>		
		Alabama	EPA region four <sup>c</sup>	US
Demographic Index	(% minority + % low-income) / 2	93	93	93
Minority Population	Individuals in a block group who list their racial status as a race other than white alone and/or list their ethnicity as Hispanic or Latino	87	85	83
Low Income Population	A block group's population in households where the household income is less than or equal to twice the federal "poverty level"	95	95	96
Environmental indicators (EI) <sup>c</sup>	EJ index (raw data) <sup>d</sup>	EJ index percentile <sup>a</sup>		
		Alabama	EPA region four	US
Lead Paint	0.25 * (0.81-0.36) *2,046 = 230.18	91	91	86
Superfund Proximity	0.0094 * (0.81-0.36) *2,046 = 8.65	75	67	67
Wastewater Discharge Indicator	0.00012*(0.81-0.36) *2,046 = 0.11	77	85	83
Hazardous Waste Proximity	0.012 *(0.81-0.36) *2,046 = 11.05	78	69	69

Abbreviations: EI, environmental indicators; EJ, environmental justice; EPA, Environmental Protection Agency.

<sup>a</sup>Red (95-100 percentile), orange (90-95 percentile), yellow (80-90), dark grey (70-80), and light grey (60-70)

<sup>b</sup>Uniontown's demographic index is in the 80 - 90th percentile and income measurement in particular is in the 90 - 95th percentiles compared to the whole US, which suggests that Uniontown, Alabama, has a significantly higher portion of minority and low-income populations, which can be considered alarming.

<sup>c</sup>The above EJ indices were developed based on the EPA-developed formula:

<sup>d</sup>EJ Index = (Environmental Indicator) × (Demographic Index for Block Group - Demographic Index for US) × (Population count for Block Group), using the EJSCREEN tool. Percentile at 50 is median. Anything above 50 is above median. The percentile values for Uniontown, Alabama are much higher than the national and state median. Although no particular policy specifies how to use EJ index percentiles (90-95 and 95-100), higher percentiles mean that exposure to environmental risk is well above national or state average and need significant attention (U. S. Environmental Protection Agency, 2017).

<sup>e</sup>EPA, region four, is serving Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee and 6 Tribes.

nonparametric two-sample Kolmogorov-Smirnov test was used to compare the levels of heavy metals in well and city water.

### 3 | FINDINGS

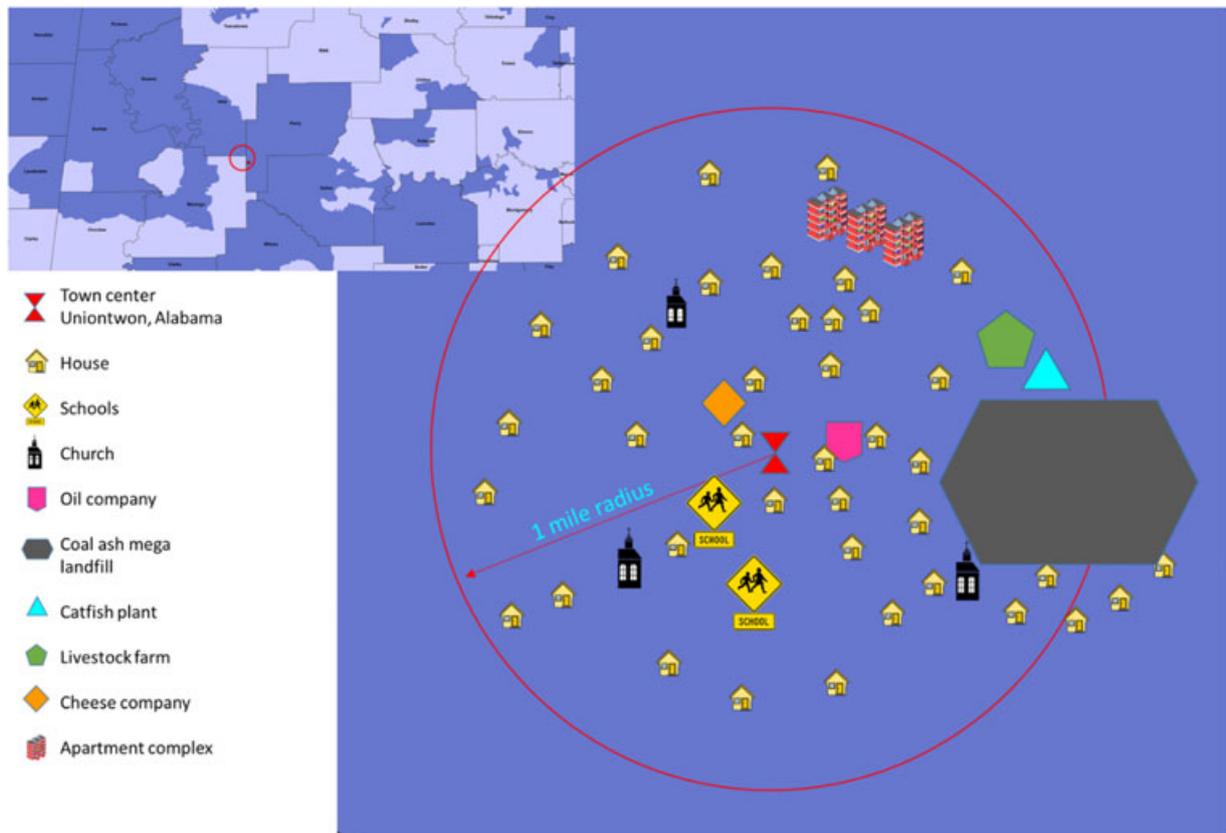
#### 3.1 | Stage 1

Uniontown, Alabama, located in Perry County, is a small town with a population of 2800, surrounded by rural areas. Most (91%) of the residents are African American, mostly unemployed and disabled; the estimated median household income is \$15 359 (57% below poverty line), and the illiteracy rate in Perry County per census data is 27%.<sup>29</sup> Only one physician, in internal medicine, is practicing in the town and there is no nurse, including public health nurse, working in this town. The nearest health department is over 20 miles away, and the nearest hospital is 30 miles away in Selma, Alabama that only has the following services: emergency care, mother and newborn, rehabilitation, sleep disorders, and women. To see a specialist the citizens should travel 60 to 95 miles to Tuscaloosa, Montgomery or Birmingham, Alabama. There is no public transportation system available in town and most individuals in Uniontown, Alabama cannot afford to travel to seek healthcare.

According to EJSCREEN's calculation, Uniontown's demographic index is in the 80th to 90th percentile and income measurement in particular is in the 90 to 95th percentiles compared to the whole US, which suggests that Uniontown, Alabama, has a significantly higher

portion of minority and low-income populations, which can be considered alarming (Table 1). In addition, we obtained EJ indices from EJSCREEN using the following environmental indicators: lead paint, superfund proximity, wastewater discharge, and hazardous waste proximity. Table 1 shows the EJ indices calculated from EJSCREEN, which is presented in the format of percentile at the state, EPA region four, and national levels. The EJ indices for all selected environmental indicators, specifically for lead paint, are well above the state, EPA region 4, and national average, which means they require special attention.

We used the EPA's EJ tools and Google maps to identify the location of residences and polluters within a one-mile radius from the center of Uniontown, Alabama. Within a mile radius from the center of Uniontown, Alabama, there are multiple polluters, such as a cheese plant, farms with livestock and catfish, a coal ash landfill, as well as residences, schools, and churches (Figure 1). In addition, this town has had a failed sewer systems or an ineffective "waste treatment" spray field for many years. This means raw sewage is transferred through long and straight pipes from residences to a field and is sprayed aboveground, and sits in open-air pools, where the water might be contaminated with *Escherichia coli* and hookworms. Hookworm is a disease of extreme poverty, which is thought to be eradicated in most parts of the developed world.<sup>30</sup> The cheese plant, which is not far from the failing sewage spray fields, adds a significant amount of rotten buttermilk (whey) to the environment and, after treatment, its effluent water is sprayed into the surrounding ponds.



**FIGURE 1** Polluters within a one-mile radius from Uniontown Center Notes. Nurse observations from Uniontown, Alabama were conducted by visiting different places, interviewing citizens, and using Google maps and EJ tools. The dark purple areas on the small map above show the EJ communities in different counties close to Uniontown. The larger map shows the polluters, schools, houses, apartments, and churches within a one-mile radius from the center of Uniontown

During our visit from the city, we had difficulty breathing the air without feeling nauseous due to the putrid smell of the cheese plant. The landfill, which contains at least 4.4 million cubic yards of coal ash, is located within one mile of the center of Uniontown, Alabama, and the nearest residence is approximately 250 feet away from the landfill (Figure 2).

Although the community faces many environmental hazards, we heard many complaints about coal ash. Among all the environmental pollution sources, coal ash has been the largest concern to the community, probably due to its impact on humans and the scale of the landfill. Therefore, we considered coal ash the community's number one priority and focused on that.

Coal ash is known to be the main byproduct of coal-burning power plants.<sup>31</sup> Coal ash contains toxic materials including metals and semimetals, such as arsenic, chromium, copper, lead, mercury, nickel, selenium, thallium, vanadium, and zinc. Fly ash is the main component of coal ash and contains small particles, less than 10 mm in diameter (PM10).<sup>32,33</sup> Exposure to PM10 and heavy metals have been associated with cardiovascular and neurological diseases, attention deficit hyperactivity disorder (ADHD), asthma, Parkinson's disease, Alzheimer's disease, brain tumors, and cancer. Lead can accumulate in the bones, blood, and soft tissues of the body and result in neurodevelopmental effects, such as lowered intelligence quotient

and behavioral problems in children.<sup>34</sup> Exposure to arsenic, a major environmental pollutant, which occurs mostly through contaminated drinking water, is associated with the skin, nervous, cardiovascular and respiratory system diseases, diabetes, and certain types of cancer.<sup>35</sup> While coal ash can affect air, water, and soil, drinking water contamination poses an immediate threat to the community's health.

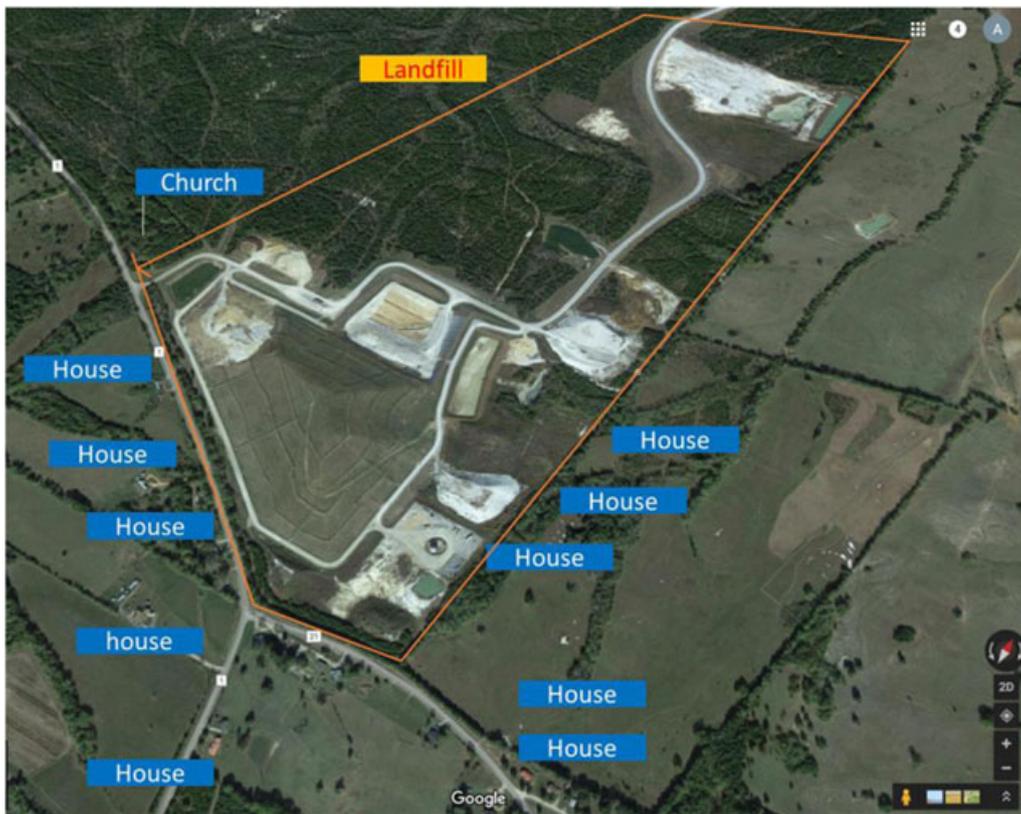
## 3.2 | Stage 2

### 3.2.1 | Focus groups

Two focus groups were held with community members who were asked the following questions.

1. What are your concerns and experiences with the environmental issues that are going on in Uniontown, Alabama? Here are what we heard most from the participants:

*"Coal ash stinks"; "Coal ash kills us and our cattle"; "I have asked myself several times, why Uniontown, Alabama? We have a lot to deal within our poor community, why should we be selected to live close to coal ash?"; "They brought ash in big well-wrapped packages. People who carried them had worn long suits and had covered their faces with*



**FIGURE 2** Arrowhead landfill and its proximity to residences. Source: Taken March 2016 by Google Maps

*a mask. They even had a shower for the workers to take a shower before they leave the field. They unwrapped packages here, but they did not cover the coal ash. If coal ash is toxic for them, why is it not for us?"*

2. What are the health issues that you think might be related to these environmental issues? The citizens expressed concerns about the coal ash landfill leading to multiple health problems, such as "kidney problems," "neuropathy," "cancer," "disability," and "mental health issues". In one statement, a community member stated:

*"Right after they brought coal ash here, three of the people who lived close to the coal ash mountains died from some sort of cancer. One of them was a neighbor who walked a lot over the road that was built for the transportation of coal ash."*

3. Do you know about the available resources from the state and community that can help you with environmental and health issues? "No"; "We know some but they are not helpful."
4. What do you need from nurses, in other words, how can we help you?

*"We want you to see us and to feel what we suffer from"; "We live in a poor community with limited*

*resources, we have to travel about 30 miles to get to the closest hospital, we need our own clinic and nurses to help us"; "please spread the words about our situation to the policymakers and others, let them know that we do not deserve to live like this."*

### 3.2.2 | Demographics and health survey

Seven participants out of 23 (31%) were unable to read and write, and three participants could just read and write at a basic level, so our eighth grade level questionnaire was too complicated for them. Therefore, only 13 participants completed the distributed health questionnaire. Most of the participants were male (62%), African American (92%), unemployed (84%), and over 40 years old (76%), with a mean age of 57 years (range, 31-71) (Table 2).

Hypertension (62%), fatigue (62%), high cholesterol (54%), chest pain (46%), arthritis (38%), gastrointestinal problems (38%), anxiety and depression (31%), breathing difficulties (23%), and thyroid disease (23%) were the most frequently reported health problems.

### 3.2.3 | Drinking water testing

Out of 59 drinking water samples, seven (12%) were well water. Two drinking water samples (3.5%) had lead levels higher than the EPA's action limit of 15 ppb (range, 16.1-51.14 ppb), six samples (10.4%)

**TABLE 2** Demographic characteristics (N = 13)

Demographic characteristics	Number, %
Age	
<40	3 (24)
40-60	5 (38)
>60	5 (38)
Sex	
Male	8 (62)
Female	5 (38)
Race	
African American	12 (92)
White	1 (8)
Hispanic	0
Education <sup>a</sup>	
Higher education, master's	2 (15)
College	1 (8)
High school	3 (23)
Less than high school	7 (54)
Employment status	
Nonemployed	11 (84)
Employed	2 (16)
Marital status	
Married	6 (46)
Single	6 (46)
Widowed	1 (8)
Disability	13 (100)

<sup>a</sup>At the time, we did not ask about literacy.

had levels higher than the health limit of 5 ppb (range, 5.17-51.14), and 12 samples (20.7%) had lead levels higher than the detection limit of 3 ppb (range, 3.34-51.14). There were also traces of arsenic in five samples (8.6%) (range, 3.13-5.4 ppb), but none of them were above the EPA's action limit of 10 ppb. We also found high levels of sodium, calcium, and potassium in some samples; however, none of these metals are regulated in drinking water, or there is not enough evidence regarding their health effects. The levels of sodium and calcium were significantly higher in well water samples ( $P < 0.015$ ) than in city water (Table 3).

### 3.3 | Stage 3

Based on the study results from stages one and two, we set a short-term goal, which was focused on reducing the citizens' exposure to

**TABLE 3** Metal levels in city and well water samples

Heavy metal	City level minus Wells level (number below shows how much lower)	P value <sup>a</sup>
Arsenic	0.4066	0.130
Calcium	0.6071	0.011
Potassium	0.4066	0.130
Sodium	0.6071	0.011
Lead	0.1511	0.754

<sup>a</sup>A two-sample Kolmogorov-Smirnov test was used to test the equality of distribution functions for small sample groups.

lead in water. We organized a 2-day workshop in November 2017, and invited families and children, local and state legislators. We also invited representatives from the EPA and ADEM, the health department's directors, and school principals, and the school superintendent for the county, but they could not attend. Fifty participants, including 13 children, attended the workshop. After sharing the results of water sampling with the participants, we gave presentations on lead exposure to adults and played the "Lead Away!" Sesame Street Lead Poisoning Prevention Project by Sesame Workshop<sup>36</sup> and distributed coloring pages and educational materials for children. We opened a discussion with the District 7 congressional representative's representative who attended the meeting and helped the citizens to express their concerns to him.

As a result of our collaboration with the community members, we set a long-term goal to reduce the EJ index and exposure to pollutants in Uniontown, Alabama. So far, the following steps have been taken:

1. Contacted the State of Alabama governor and spoke with her representatives about the Uniontown, Alabama.
2. Contacted the Alabama Department of Public Health, ADEM, and EPA to inform them of our findings and seek resources such as lead testing kits and educational materials.
3. Requested donations from companies and local investors; for example, we were able to obtain free faucet water filter systems with a 1-year filter replacement supply for 40 families.
4. Initiated free clinic arrangements, where local volunteer providers, including nurses and physicians, can come to the city and provide care to the citizens two times per year.
5. To spread the word about the Uniontown, Alabama, situation, we collaborated with a documentary filmmaker for a 10 minute documentary production,<sup>37</sup> which reached approximately one million viewers in a few weeks after distribution. The documentary brought more national and international attention to the area. For example, a representative from the United Nations visited the area in December 2017, and National Geographic visited the area in November 2017.
6. Contacted Alabama state senators and house representatives to inform them of our findings and citizens' concerns. Not all legislators and local leaders supported the community, but those who heard us are still working to solve these problems. We followed up with Alabama Senator, Doug Jones, and congressional representative Terri Sewell and had several conversations with their officers. Because of these discussions and with community members' hard work, in summer 2018, \$20,000,000 was secured from the USDA to improve the failed sewer system in Uniontown, Alabama.
7. Educated community members on how to speak and write letters to their legislators and ask for change.

## 4 | DISCUSSION

We used a CBPR, a recommended EJ research framework, a three-stage community-based mixed methods research strategy. CBPR

involves academic-community collaborations, where researchers' authority is shared in all stages of the research process, including observing, conducting, interpreting, intervention, and taking action, with the community members.<sup>3</sup> Instead of doing enough up-front project design and collecting one-time data, we collected data in three stages and designed subsequent stages based on the results of the former stage and community's perspectives. Our results showed that Uniontown, Alabama, is an EJ community based on the EJ index and levels of minority and poverty. The community suffers from poverty, illiteracy, and lack of resources, and lacks knowledge on how to protect themselves from exposure to environmental hazards. Nurses can familiarize themselves with EJ screening tools<sup>38</sup> or use census data to recognize the EJ situation of the area in which they live or work. They can also simply ask their clients about their proximity to industry or other possible polluters. Nurses in California can use the web-based easy-to-use screening tool, CalEnviroScreen, to identify EJ communities that are affected by multiple pollution sources.<sup>39</sup> This tool is available only for California.

The focus group findings showed that people of Uniontown, Alabama are concerned about the environmental issues, especially coal ash and their impact on their health. In addition, this community has felt discriminated by saying that *"They brought ash in big well-wrapped packages. People who carried them had worn long suits and had covered their faces with a mask. They even had a shower for the workers to take a shower before they leave the field. They unwrapped packages here, but they did not cover the coal ash. If coal ash is toxic for them, why it is not for us?"* Furthermore, the community feels hopeless by expressing that they do not know any resources that can help them with environmental and health issues. This means that the definition of EJ concept that all people and communities should be treated fairly and equally regardless of their race and socioeconomic status<sup>20</sup> was not applied for this community and concerns of community members have not been considered in the decision-making process about dumping coal ash.

The findings showed that residents of Uniontown, Alabama, suffer from disabilities, hypertension, respiratory, and heart diseases. Although the literature shows a possible connection between air pollution and/or coal ash and these diseases, we did not set out to test this relationship. Our findings on the health problems helped us in planning for running free clinics and describing the city's situation with legislators.

We collected only 13 health questionnaires because 10 of our participants were unable to read and write or could only read and write at a very basic level. Due to the time limitation during our workshop, we could not interview these participants. We should have engaged the community members in selecting or designing the health questionnaire tool, but we did not think that we would have that many illiterate community members. In addition, we used the standard education classification provided by the Bureau of Labor Statistics<sup>40</sup> in our questionnaire. This classification is used by many clinicians and researchers, but does not include illiteracy or basic writing and reading knowledge. Nurses usually do not ask about their clients reading and writing skills and provide brochures and

educational materials to educate their clients, and, most of the time, due to time limitations, they do not ask their clients to read them in front of them. Nurses must ask their clients about literacy and anything that influences their understanding of health information before distributing questionnaires and educational materials. We approached the Alabama Department of Public Health to see if they have any pictorial brochures about the lead that we could use in our educational workshops, but they had none.

We found lead levels higher than the health limit at 10.4% and traces of arsenic at 8.6% in drinking water samples of Uniontown, Alabama. More studies are required to help us understand how the drinking water in this town was contaminated with heavy metals. In the meantime, we should raise the community's awareness about lead exposure prevention. Research has shown that community education significantly reduces lead exposure, especially in children.<sup>41</sup> We also found considerable levels of sodium and calcium in most water samples. Nurses should know that increasing the daily consumption of these minerals through food and dietary supplements in addition to the high levels that are already present in drinking water can become a health concern. The WHO warned about this matter and the interaction between these elements and other ingredients in water, food, and air in 2009.<sup>42</sup>

Nurses should ask their clients about the source of their drinking water and whether it is well or city water. Public water systems treat water and monitor its contamination to protect customers; however, well owners are responsible for testing their own water.<sup>43</sup> This study showed that the levels of calcium and sodium were significantly higher in well water compared with city water samples ( $P < 0.011$ ). Therefore, well water users should be aware of these high levels and be educated about the importance of testing their well water at least once a year.<sup>43</sup> The results of this study are not generalizable to other places in the United States because contamination of groundwater that feeds well water happens based on the structure of the soil in the area as well as human activity and proximity to polluters, such as a coal ash landfill, coal-burning power plant, local industries, and septic tanks.<sup>43</sup>

Community education is the most important part of the CBPR. Nurses can develop community-based programs to build capacity to help EJ communities overcome environmental and political barriers.<sup>44,45</sup> They can work with the communities in reducing their exposures to potential hazards and alleviate related signs and symptoms. For instance, in a community-based program, Shani et al<sup>45</sup> designed an evidence-based intervention and used Asthma Control test (ACT) and the EPA's Asthma Home Environment Checklist to manage pediatric asthma.<sup>21</sup> In their innovative intervention, peer counselors reinforced asthma management messages and facilitated the completion of Asthma Action Plans. The EJ community partner organized block cleanups to reduce outdoor triggers. In another study, public health nurses connected with families and delivered tailored information and guidance to parents about environmental self-efficacy and environmental health precautionary adoption.<sup>46</sup> Therefore, it is important for nurses to educate themselves about environmental pollutants and their health impact and EJSCREEN tools.

Collaboration between a nurse and public health/political science specialist helped the authors to plan and intervene in the current policies of state and federal laws. This collaboration was most helpful in the third stage, where short-term and long-term goals were set to inform legislators about the situation in Uniontown, Alabama, and to educate communities on how to contact their legislators. Therefore, nurses are encouraged to advocate for EJ in low income and minority communities and team up with other health professionals and politicians to create a stronger advocate group.

The limitations and challenges in conducting research and applying any interventions are unique to EJ communities. In EJ communities, an unjust health disparity is systematically associated with social disadvantages, which places an already disadvantaged social group at a further disadvantage.<sup>3,33</sup> The combination of poverty and environmental exposures creates a vicious cycle that makes it difficult to identify what exactly causes the health disparities and how and where poverty and exposure overlaps. While planning free clinics, we faced barriers of a lack of malpractice protection for volunteers and out of state health professionals who do not have a practicing license in Alabama. These barriers urged us to work on changes to the state law, which is slowly underway.

It is recommended that nurses improve their knowledge about EJ, environmental exposure and their health effects and ask their clients about their reading and writing skills as well as the environment in which they live in regard to any possible polluters. After recognizing an affected environment, we encourage nurses to make observations of the community and use the available tools to locate polluters, become involved in community activities, and make connections with community leaders and churches before taking any action. Nurses and researchers should be creative in their efforts to collect information from EJ communities. This paper is an example of advocacy. Advocacy for EJ communities, small or large, can improve the quality of life in EJ communities. Nurses should stand up for those communities and individuals affected by environmental injustice.

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