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CASE REPORT

Successful Superfund Remediation in Pueblo, Colorado: A Provocative Reflection on Community Engagement and Empowerment

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ABSTRACT

The city of Pueblo, Colorado has a long industrial past; shortly after the nascence of the settlement, the city began to establish itself as a major hub for the smelting of mined materials transported into town from the Front Range. Between 1880 and 1921, five main smelters were established and operated in and around the city's center. Though the smelting activities ended over a century ago, they left behind a topsoil contaminated with toxic heavy metals, putting local residents at health and socio-economic risks. Epidemiological studies showed elevated blood lead levels in children living near the smelters and caused the site to be listed on the U.S. Environmental Protection Agency Superfund National Priorities List. This report describes how industrial activities degraded the environment in the city and compromised public heath, the history of the Superfund law, and how communities in the affected neighborhoods collectively organized to stand up for themselves and partake in all aspects of the Superfund remediation process in order to secure a healthy living environment. The paper shows that, regardless of background or socio-economic status, when average citizens engage and empower themselves by working with stakeholders and elected or executive leaders at the local, regional and national levels, almost anything can be accomplished in the interests of all. The paper provides a reflection on the potential implications of inaction by the scientific and leadership groups in the face of growing global environmental degradation and public health risks.

Keywords: Superfund, heavy metal contamination, environmental justice, public health

Introduction

Epidemiological studies have documented the association between public health risks and various forms of exposure to hazardous chemicals. The exposure can be environmental or occupational, and can come through the air, soil, water and/or food supplies. Regardless of the source of exposure, its socio-economic impact, or the nature of the resulting health outcome, medical intervention is typically the endpoint. Recent studies show that extreme weathers affect the bioaccessibility of soil heavy metals and could be associated with increased exposure risks to conditions like cancer.[1] These extreme weathers may be linked to climate change and can result in increased exposure to destabilized hazardous chemical wastes. Unfortunately, this global pattern of climate change and the associated extreme conditions are predicted to intensify in the future.[2,3]

Worldwide, there are many regulatory bodies charged with addressing these environmental issues. However, these agencies often intervene as separate entities, depending on the country and the leadership in a given country. Therefore, the efforts geared at minimizing the health impact of environmental contaminants are not always coordinated due to the lack of communication or mutual consultation. In many instances, environmental policies are decided by the country leadership, not the scientific community, and these policies are often influenced by corporate groups. So the question "What are scientists Doing and why?" deserves the attention of the scientific community. While researchers around the world are working hard and constantly making breakthroughs in their respective areas of expertise, there is no productive communication or exchange among them, or their findings remain purely academic. Yet, in the absence of this coordination and the involvement of leadership in implementing research recommendations, a real progress to minimize public exposure to environmental contamination and related health risks is limited. For instance, treating environmentally-induced medical conditions such as cancer, heart problems or reproductive abnormalities without due attention to the etiology of the disease might be a short-sighted approach, no matter the efforts of the medical community. Yet, this crisis management attitude is observed around much of the world, as opposed to effective preventive measures. It would be hard to address heavy metal-induced adverse effects through medical intervention alone. The prevention of the socio-economic implications of exposure to environmental insults is equally relevant.

This paper highlights the importance of an integrative approach to address health risks associated with environmental degradation and contamination using basic research. Environmental science is a multidisciplinary field that encompasses biological sciences such as medical research as well as social sciences such sociology, economy and public policy. The various areas of this field cannot be dissociated; in fact, their integration is crucial in understanding human interactions with our environment and protecting public health. In order for it to continue to serve the communities proficiently, medical research needs this integration and should not be an independent science dealing with only the treatment of a disease, with no preventive outlook. The authors hope that this reflective report, based on an actual case study of community engagement in the remediation of environmental contamination, will initiate a broader exchange among interdisciplinary researchers and public leaders in the common endeavor of addressing public health concerns related to environmental toxicants.

Historical Perspective of Landscape Contamination in Pueblo, Colorado

Pueblo, Colorado has a long industrial past; shortly after the nascence of the settlement, the city began to establish itself as a major hub for the smelting of mined materials transported into town from the Front Range.[4-7] Between 1880 and 1921, five main smelters were established and operated in and around the city's center. By 1909, Pueblo was considered as the major steel town west of the Mississippi. These five smelters included the Blend Zinc Smelter (also known as the United States Zinc Company), the Colorado Smelter (also known as the Boston & Colorado Smelter, or the Eilers Plant), the Massachusetts Smelter (also known as the Ill-Fated New England Smelter), the Philadelphia Smelter, and the Pueblo Smelting and Refining Company. In addition to the smelters, there was the Colorado Coal and Iron Company steel mill (also known as the Colorado Fuel and Iron Company steel mill or CF&I). These smelters processed various types of ores to produce gold, lead, silver, copper and zinc. The ores used by the smelters contained high levels of metals; including iron, lead, copper, silver and zinc. The CF&I steel mill, which was not considered a smelter, processed pig iron to produce steel. By 1918, three of the five smelters were dismantled or had their activities gradually declining in the state; this included the main smelter, the Colorado Smelter, which closed in 1908. The remaining two smelters were destroyed in 1921 by the Pueblo's great flood of the Arkansas River, putting an end to all smelting activities in the city.[4,5] However, the CF&I (later renamed Rocky Mountain Steel Mill-RMSM and then EVRAZ North America) was still in operation.[4]

Early during its operations in the late 1800s, the CF&I used coal in a coke plant to process pig iron as main raw material and yield steel and iron products.[8] Iron ore, carbon and impurities such as heavy metals were the primary components of pig iron. To put these operations into perspective and for later analysis in this article, it should be mentioned that the first annual report of CF&I summarized its activities from November 1892 to August 1893.[7,8] The report shows that in less than a year, the plant covered over 41 square kilometers and operated three blast furnaces with a daily production capacity of 400 tons of pig iron, one converter with a daily capacity of 500 tons of steel ingots, one blooming and rail mill producing 500 tons of blooms and 300 tons of rails, and other equipment of smaller capacity. By 1907, the plant used 714,578 tons of iron ore and 1,555,774 tons of coal to produce 362,728 tons of pig iron, 615,481 tons of ingots, 165,787 tons of rails, 70,318 tons of rail accessories, 290,875 tons of limestone and dolomite, 454,513 tons of coke, and 268,398 tons of other steel products plus a good amount of coke by-products. The wastes resulting from the blast furnaces were reportedly dumped down a ravine along its western border. These

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solid wastes, in the form of slag pile mainly consisted of lead oxides produced during the industrial activities. CF&I ceased operations in 1908. Since that time, the plant has been processing scrap materials to make various steel products. Yet, from the mid-1800s to early 1900s, residential houses were built around the CF&I to accommodate workers.[7] The land use pattern around the mill remains the same to date and the central business area is adjacent to some of Pueblo's poorest neighborhoods based on US Census data,[9] raising concerns for environmental justice.

Among the heavy metals resulting from the city's industrial activities, lead (Pb) exposure is the greatest concern in the U.S. from the public health standpoint because it can result in a range of serious health risks, particularly among young children and pregnant women. Human exposure to environmental Pb occurs mainly through inhalation and ingestion, and Pb exposure adversely affects almost every organ and organ system of the body.[10-15] The reader is referred to a recent comprehensive review of the pharmacogenetics of Pb toxicity by Diawara[15] for more details about the adverse health effects of Pb exposure, the toxicokinetics of Pb, as well as the impact of various levels of environmental and occupational exposure to Pb. Briefly, Pb has been shown to adversely affect the central nervous system in both children and adults, the reproductive system, the immune system, the musculoskeletal system, the endocrine system, the gastrointestinal system, the respiratory system, the cardiovascular system, the hepatic function, ocular function, as well as growth and development.

As stated earlier, the smelting activities ended in the city of Pueblo in 1921 and since the 1980s, the CF&I plant has been processing scrap materials to make various steel products.[4] However, by-products of the past industrial activities, especially at the site of the Colorado Smelter, still exist in the Bessemer area of town, especially, along the western side of South Santa Fe Avenue in the form of slag heaps, and the potential for environmental contamination has been a public concern. Between 1992 and 1995, the Hazardous Materials and Waste Management Division (HMWMD) of the Colorado Department of Public Health and Environment (CDPHE) conducted a small-scale sampling in areas of Pueblo to determine the hazardous elements in the waste and slag piles and at other sites with a history of smelting.[4] Analysis of 13 samples showed soil Pb concentrations varying from 11.2 mg/kg to 318 mg/kg at the residential sites and from 598 mg/kg to 7,640 mg/kg at the waste slag plies.

Between 2004 and 2005, Diawara and colleagues at Colorado State University Pueblo conducted a systematic geochemical characterization of topsoil across Pueblo, Colorado for heavy metals, and generated prediction maps using kriging spatial analysis interpolation technique.[7] The study found Pb levels between 18 mg/kg and 316 mg/kg, with the concentrations exceeding 300 mg/kg in many low-income residential communities. Although these soil Pb levels were below the U.S. Environmental Protection Agency (EPA)'s benchmark of 400 mg/kg for cleanup, the authors raised concerns about potential environmental contamination and expressed the need for a more comprehensive study and approach to address public health and economic risks in these communities.

Based on the report by Diawara and co-workers and concerns raised therein,[7] the HMWMD of CDPHE conducted a study in June 2010 focused near the historical Colorado Smelter site, which has residential neighborhoods around it.[16] Sampled were collected from four locations of waste piles and 47 residential properties around the main historical Colorado Smelter site. The results showed that all of the soil samples collected along the four waste piles had Pb levels higher than the EPA's benchmark of 400 mg/kg, with levels varying from 1,280 to 8,070 mg/kg. The Pb concentrations in soil from residential areas varied from 36 mg/kg to 785 mg/kg, and these levels decreased as the distance increased from the former Colorado Smelter site. These initial findings resulted in the use of the Emergency Response authority by the EPA to remove 19,000 tons of contaminated soil from 11 residential properties around the historic Colorado Smelter site. As discussed below, an Emergency Response is a provision under the Superfund law to protect public health in a contaminated area before a site is put on the Superfund National Priorities List.

Pueblo on the National Priorities List of the Superfund

The above mentioned findings about heavy metal contamination of topsoil in Pueblo, especially in residential areas, raised major public health concerns and sparked serious and sometimes contentious discussions about putting the affected neighborhoods of the city on the National Priorities List for potential remediation. On one hand, the EPA and Colorado Department of Public Health and Environment (CDPHE) as regulatory agencies were strongly advocating for listing Pueblo on the EPA Superfund National Priorities List. On the opposite hand, the residents of the affected neighborhoods were extremely concerned about such decision and its impact on the city's reputation. The Pueblo City Council Representatives and the Pueblo County Commissioners were caught in the middle. Before elaborating on the community involvements in this case study of Superfund remediation in Pueblo, Colorado, let's first examine the Superfund law. What is the Superfund law and what is the National Priorities List?

The U.S. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA-aka Superfund law) was passed in 1980 in response to severity of the Love Canal contamination.[17] The Love Canal was originally meant to provide inexpensive hydroelectric power in a dream community by William T. Love. However, the project was abandoned and the land was sold in 1920 to the Hooker Chemical Company (now Occidental Chemical Corporation) which turned it into a dumpsite of 21,000 tons of hazardous chemical wastes, including dioxin. The canal was then covered with dirt by the chemical company and leased to the Niagara Falls School District in 1953. In the late 1950s, homes and an elementary school were built around the site. In the 1960s, residents started complaining about odors and residues. By the late 1970s, contaminated groundwater

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was flowing through sewer lines and into creeks, exposing populations to toxic chemicals like dioxin. The residents started reporting major health issues. The EPA and the New York State Department of Environmental Conservation conducted an investigation and concluded that the land was contaminated. There was no Superfund law at the time; therefore, President Jimmy Carter issued a first declaration of a public health emergency in 1978 and a second emergency declaration in 1980, providing federal funding for cleanup. The residents were evacuated.

Research later linked exposure to the hazardous chemicals to increased rates of cancer incidence and birth defects among residents who lived on Love Canal prior to evacuation. One study found that these residents experienced higher rates of preterm born babies and infants with teratogenic effects such as congenital malformations and low birth weights.[18] These residents also had a higher rate of female to male ratio than normal. Another study examined the standardized incidence ratios (SIRs) among Love Canal residents and residents of New York State (NYS) and Niagara County.[19] The researchers reported "elevated SIRs relative to NYS for some cancer site groupings, including kidney and bladder for each sex, respiratory and stomach in men, and rectal cancer in women, although the 95% CIs for these groups included 1.00 because of small numbers," but concluded that, overall, the Love Canal cohort from 1979-1996 did not have higher cancer rate than NYS and Niagara County.

The Superfund law was passed in 1980, "providing authority for funding and cleaning up of inactive hazardous waste disposal sites, spills, and other discharges of hazardous substances into the environment."[17,20] The Superfund law of 1980 and its subsequent amendments enable the EPA to hold the chemical company liable and compel it to help with cost of the 21-year remediation effort. The law is response-oriented. It has a tough liability scheme: it is retroactive (liable for past actions) and strict (liable without fault, the government needs not prove intent or negligence). The law is joint and several (each and every potentially responsible party is liable for entire cost). It defines response standards for cleanup, mandates public involvement in response activities, and requires state interaction in response activities.

In 1983, the National Priorities List (NPL) was introduced, with the Love Canal placed as the first site on the NPL in September 1983.[21] The Valley of the Drums waste dump in Kentucky was another environmental disaster site listed the same year. The NPL is "intended primarily to guide the EPA in determining which sites warrant further investigation" and potential subsequent remediation. The Superfund remediation sites are first proposed to NPL in federal register. The EPA then accepts public comment and screens the site based on their Hazard Ranking System (HRS) score. However, it is shown that remediation and subsequent deletion of a site from the NPL is related to the length of its listing regardless of HRS.[22] States and territories can designate a top-priority site regardless of score.

The Superfund process involves ten phases, with the first six providing for community participation.[18] These phases are 1) The Preliminary Assessment/Site Inspection, which consists of a relatively low-cost review of existing site information to determine the need for further action, and a more in in-depth assessment of on-site conditions and characteristics to determine if a site presents enough of a threat to qualify for the NPL. 2) The Remedial Investigation (RI), this further assesses the site's problems in more details to determine the existence and nature of threat to human or environmental, define the extent and treatability of contamination, and recommends an Emergency Removal Action if an immediate threat is found during phases 1 or 2. As mentioned above, this Emergency Response authority was used by the EPA to remove 19,000 tons of hazardous wastes from the Colorado or Blende Smelter site in Pueblo, Colorado. 3) The Feasibility Study; this is sometimes combined with RI and assesses the treatability of site contamination and evaluates the potential performance and cost of treatment technologies. 4) The Proposed Plan requires a public participation document addressing threat to human health and environment, explains key aspects of the RI/FS, gives rationale for the preferred alternative, and seeks public review and comment on all alternatives presented. The community is given the opportunity to have a public meeting and submit comments within 30-60 days. 5) The Record of Decision (ROD) is a public document final remedial action plan or cleanup alternative(s) for the site that contains a formal statement making ROD legal and binding, and provides an overview of the problems and risks posed, removal action alternative, analysis of the alternatives, and rationale for selection of remedy, and addresses comments received from the public. 6) The Remedial Design is the engineering phase in which technical plans are developed for the selected remedy documented in the ROD and includes community relations activities as key element.

Based on soil contamination data from the CDPHE[23] and researchers at Colorado State University Pueblo (CSU Pueblo),[7] the EPA contacted residents in affected neighborhoods in Pueblo in April 2012 about wanting to put the affected areas of town (i.e., Bojon Town and Bessemer) on the EPA Superfund NPL.[24] The residents started setting up meetings immediately. These residents were scared and confused for a number of reasons: for them, a) two generations had followed since the end of smelting operations in 1908 and no cognitive impairment nor other health issues were reported in the neighborhoods; b) they did not have lower life span than people in other parts of town; and c) there was no evidence of higher blood levels in the residents of the area compared to people in other parts of town. In addition, they were concerned about the general view and commercial development of the neighborhood. Thus, they expressed an initial opposition to the site being listed on the NPL.

Reactions of Pueblo Residents to National Priorities Listing

As mentioned earlier, the Superfund process provides for

significant community involvement.[17] In Pueblo, the community leaders in the affected neighborhoods, the Pueblo City Council Representatives, the Pueblo County Commissioners, the EPA researchers and officers were all involved in the controversial resolution of potentially listing the city on the EPA National Priorities List. This was not an easy decision because placing a site on the NPL does not immediately guaranty remediation, and once a site is placed on NPL, it cannot be removed unless the cleanup process is complete. Consequently, the community concern was justified.

Data provided by the EPA were understandably examined with suspicion by the communities under the circumstances. However, a new study, conducted by independent researchers at CSU Pueblo and funded by the university and the City, tested 240 children in Pueblo for blood Pb levels (BLLs).[25] This independent research found that 7.5% of Pueblo children had BLLs above the Centers for Disease Control and Prevention (CDC) reference level of 5 µg/dL for elevated BLL, and 18.3% of children had BLLs between 3.3–4.9 µg/dL. Out of the 36 children who lived near former smelters, 13.9% had BLLs above 5 µg/dL vs. 6.37% for children living away from old smelters. The proportion of Pueblo children with elevated BLL was nearly three times the 2007–2010 U.S. national average (7.5% vs. 2.6%), and this number was even higher in the immediate vicinity of old smelters (13.9% vs. 2.6%). There was a significant association between distance from old smelters and children BLLs. Around 38.5% of houses sampled near the smelters had topsoil Pb levels higher than the EPA's benchmark of 400 mg/kg. These new findings caused the Pueblo City Council to support the NPL listing.

The decision of the City Council to support the listing of the city on the NPL brought a change of attitude in the community. On 9 January 2014, the residents of Bojon Town and Bessemer decided to appeal to the Governor of the State of Colorado, by writing him a letter with 27 talking points. The residents expressed their support for the listing as long as certain protections were put in place. Among others they requested for the EPA to

a. Do continuous testing of children's blood Pb levels
b. Prioritize homes with children and homes with very high Pb levels
c. Establish a 5-year timeline to complete the remediation
d. Meet their deadline for start of remediation
e. Work with the Citizens Advisory Group (CAG) formed by the communities to keep them appraised of actions to be taken and progress made, and
f. Conduct the cleanup in a timely, effective and collaborative fashion.

The Governor of Colorado responded to the letter of the Bojon Town and Bessemer communities on January 21, 2014.[26] Governor John Hickenlooper expressed support for the listing of the sites on the NPL to protect current and future residents, provided that the EPA addresses the concerns and expectations raised by the communities in their 9 January 2014 letter.

The Colorado Smelter Superfund Site was listed on the EPA National Priorities List in December 2014, following community empowerment. Under the Superfund law, the EPA is able to identify, investigate, and remediate sites like old mines, smelters, or factories, and is given the authority to hold potentially responsible parties (PRPs) financially liable for the cleanup. Monies from the PRPs are set aside into a large fund for the site, hence the name Superfund. However, in some cases, the contaminated sites are so old that there is no PRP still in existence – this is true for Pueblo; as explained earlier, the former smelter had been closed for over a century. Thus, the Colorado Smelter Superfund Site is labeled as an orphan site, and the monies for the remediation had to come directly from the federal government via the Superfund Trust Fund. The total estimated cost of the cleanup has reached $74 million.

In Pueblo, remediation was carried out in two parts.[24] The EPA assessed Pb and arsenic (As) levels inside homes via house dust and outside homes via yard topsoil. If Pb and As levels were deemed high enough in either area, the residents had the option to allow EPA's contractors to come in and clean up for free. In the case of a dust cleanup, a thorough house cleaning was done. In the case of a yard cleanup, the top 45 or 60 cm of soils were removed and replaced, depending on whether the yard was a child play area, and new landscaping was installed over the top.

As of the time this article was written in May and June 2025, the EPA has completed indoor dust cleanups for 568 residential properties out of their goal 635 properties (89%). For topsoil cleanups, they have completed 813 of their goal 858 properties (95%). It is important to note here that cleanups are voluntary, and some residents chose to decline being sampled or remediated. Therefore, it is unlikely that the cleanup will reach a 100% completion status.

Community Engagement

Community engagement and cooperation have been foundational components to the Superfund cleanup in Pueblo, Colorado. At the beginning of this process, a Community Advisory Group, or CAG, was formed to give residents and stakeholders a seat at the table during the Superfund cleanup process.[27] These groups are often made up of people who live or work near the site, as well as tribal members, local officials, public health representatives, and business owners. CAGs serve as a formal mechanism for the community to provide input into the cleanup and decision-making processes, and their structure typically includes regular meetings, designated leadership roles, and subcommittees as needed for specific issues.

While CAGs operate independently, they work closely with the EPA, which facilitates communication and often provides technical support or liaisons to attend meetings. In the case of Pueblo, representatives from Pueblo Department of Public Health and Environment (PDPHE), the contractor hired to carry out the remediation, the city government, local non-profit organizations, and various other businesses participate, each ensuring that human health concerns are incorporated into cleanup plans. They meet monthly, either virtually or in person, and each person is given the chance to voice their questions,

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comments, or concerns. A mediator facilitates each meeting, manages the schedule, and gracefully ensures that all members remain civil, respectful, and on topic. This relationship between the community, the EPA, and public health officials is critical for ensuring that site remediation efforts are transparent, science-based, and aligned with the needs and values of the affected population.

In addition to the CAG, several other organizations work with the community to support and protect the health and wellbeing of all residents. PDPHE has provided services to keep the community aware of the risk: they offer free blood Pb level testing for people of all ages who are concerned about Pb exposure, hold Pb workshops to educate citizens about how to minimize Pb exposure in their homes, and do home inspections for Pb paint, which is another potential mode of Pb exposure.

The Pueblo Urban Renewal Authority (PURA) is a public redevelopment agency established in 1959 by the City of Pueblo, Colorado.[28] Operating as a separate public body under Colorado law, PURA is governed by an 11-member board of commissioners appointed by the Pueblo City Council. While PURA functions independently, it collaborates closely with the City Council and other local entities to implement redevelopment initiatives. The agency's primary mission is to eliminate and prevent urban blight, thereby enhancing the economic vitality and quality of life within the community. It achieves this by identifying areas in need of revitalization and facilitating redevelopment projects that stimulate private investment, improve public infrastructure, and create job opportunities. The partially vacant commercial district and crumbling roads and sidewalks already make the area around the Superfund site a good candidate for such revitalization assistance, and the addition of the Superfund site led to the creation of the Colorado Smelter Revitalization Plan (CSRP).[29] This plan is addressed more fully below.

To help fund projects such as the Colorado Smelter Revitalization Plan, PURA utilizes financial tools such as Tax Increment Financing (TIF), which captures the increased tax revenues resulting from rising property values in redeveloped areas. These funds are then reinvested into the community to support further improvements. Additionally, PURA has the authority to acquire, rehabilitate, and sell or lease properties, and, when necessary, can exercise eminent domain to facilitate redevelopment efforts. PURA's operations are guided by the Colorado Urban Renewal Law (C.R.S. 31-25-101), which outlines the criteria for identifying blighted areas and the procedures for redevelopment. Through its initiatives, PURA aims to foster sustainable growth, preserve historical assets, and enhance the overall livability of Pueblo.

The Colorado Smelter Revitalization Plan (CSRP) is a collaborative initiative led by EPA in partnership with the City of Pueblo, PURA, PDPHE, the CAG, and other local groups. This project focuses on revitalizing the neighborhoods surrounding the former Colorado Smelter Superfund site, specifically Bessemer, Eiler's Heights (also known as Bojon Town), and the Grove. The EPA launched this plan as part of the Superfund Redevelopment Program, which is the final step in the Superfund process. Several projects within this plan have been completed, as detailed below.

As part of the Colorado Smelter Revitalization Plan, two early projects, the Pueblo History and Art Walk[30] and a series of beautification and safety infrastructure upgrades, were completed to enhance neighborhood pride and improve public spaces. The Pueblo History and Art Walk celebrates the cultural and historical identity of the Bessemer, Eiler's Heights/Bojon Town, and Grove neighborhoods through a series of walking loops that start and end at the Pueblo Riverwalk. Along the routes, wayfinding and gateway signs were installed, and three art sculptures were added to reflect community character and encourage outdoor activity. In tandem, the beautification and infrastructure initiative focused on creating more inviting and safer spaces. This included wrapping utility boxes and vacant storefronts with historic photographs, creating new murals, and installing safety enhancements such as improved walkways, directional signage, and recreational amenities. These projects not only improved the visual appeal of the neighborhoods but also helped reconnect residents to their shared history and promote greater community involvement. Alongside these physical improvements, organizations like NeighborWorks have played a key role in supporting revitalization efforts and fostering long-term community investment.

NeighborWorks Southern Colorado, originally founded in 1977 as Neighborhood Housing Services of Pueblo, is a public non-profit organization created to bring together residents, businesses, and local government to prevent neighborhood decline and promote homeownership.[31] The organization provides tools and services such as educational courses for new homebuyers, credit counseling, small business lending, and down payment assistance. NeighborWorks focuses on strengthening community ties and encouraging investment in Pueblo's neighborhoods, especially in Bessemer, Eiler's Heights/Bojon Town, and the Grove. They are a partner organization in the Colorado Smelter Revitalization Project along with EPA, PURA, the CAG, and PDPHE.

Future Framework and Plans

Community members and local organizations are actively planning and carrying out revitalization and improvement efforts throughout the area. The Colorado Smelter Revitalization Plan outlines several proposed future projects, including the creation of trails that connect neighborhoods to nearby recreation sites, as well as the addition of lighting, parking, bike lanes, public art, landscaping, and signage. Plans also include building public plazas to serve as gathering spaces for residents and promote events such as farmers markets and neighborhood get togethers. The coalition supporting these initiatives aims to strengthen neighborhood infrastructure, encourage economic development, protect access to affordable housing, honor cultural heritage, and build a sense of community pride. These efforts complement the Superfund cleanup by supporting the restoration of a safe, vibrant, and healthy living environment in Pueblo.

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Residential remediation has been considered complete since February 2025, but EPA is still offering sampling for any homes that have not been sampled. The site is still not considered fully remediated, as the non-residential portion of the site containing the historic smelter footprint is in the remedial investigation stage of the cleanup process. As of yet, the EPA is uncertain of an estimated completion date. After all remediation and post construction is complete, the EPA will continue to review the site every five years to reassess the contamination and ensure there is no heightened risk of public exposure. National Priorities List deletion, the second to last phase in the Superfund process can take two decades.

Critical Reflections

The Hispanic or Latino population represents the largest demographic group in the city of Pueblo, with 48.4% of the 2020 census population.[9] As mentioned earlier, the land use pattern around the Superfund site in Pueblo raised concerns for environmental justice. A similar pattern is reported by a study that examined Florida Census data and showed Black and Hispanic groups near Superfund sites.[32] Other studies have also shown that populations living near Superfund sites are ethnic minorities and/or low-income populations, clearly demonstrating inequalities in the physical location of Superfund sites.[32-34] In addition, it is reported that the Superfund program benefited more the wealthy[35] and that its sites designation occurred at lower rate in communities with low-income minorities.[36]

Although concerns have been expressed about potential inequities in the benefits from the Superfund designation and cleanup efforts and in the prioritization of Superfund sites for remediation in different communities, it should be mentioned that this analysis can be complex because environmental justice is challenging. In addition, the remediation process takes time and site demographic changes as a result of the listing itself or the subsequent cleanup. Yet, addressing the racial disparities in Superfund remediation remains crucial considering the benefits of Superfund cleanup, or the potential health and economic risks associated with lack thereof. For instance, it has been reported that living in proximity of a Superfund site can reduced life expectancy by as much as 1.22 years.[37] Another study found that living within 2 km of a Superfund site increased the risks of congenital abnormalities in new born babies by up to 25% before cleanup.[38] This is consistent with studies reported about the Love Canal residents.[18] Proximity to Superfund sites has also been associated with increased costs of health care[39] and decreased real estate values.[40]

The Superfund law is a U.S. program, and there is no European equivalent of this U.S. law at the moment. In addition to national laws implemented in individual countries or states, the European Union (EU) instead implements directives (EU Directives) such as the Waste Framework Directives, the Soil Thermatic Strategy and the Soil Charter to prevent and manage contaminated sites.[41,42] The EU has a rather decentralized strategy to deal with environmental issues. The “Super Fund” of the European Innovation Council, sometimes confused with the U.S. EPA Superfund law, is rather an innovation program to support the commercialization of high-impact technologies.[43]

Considering the current trend of habitat destruction and environmental degradation and contamination, there is a need for harmonization of international strategies to address current and future global environmental issues, which are even more critical in nations overseas (e.g., African, South American and Asian countries). The world is becoming connected in unprecedented historical manners. Despite its flaws, the Superfund laws has helped communities recover, as evidenced by the case reported herein. Therefore, it is not unreasonable to suggest that the international scientific communities and regulatory bodies should assume the responsibility to develop comprehensives environmental regulations, modeled after the EPA Superfund law, if necessary, that would enable nations to sustainably exploit the mineral resources needed for development without compromising their own or global ecosystem.

It has been over a century since the end of the industrial activities that resulted in the environmental degradation of neighborhoods in Pueblo, Colorado, and the subsequent Superfund remediation described in this paper. This case report shows that the environmental contamination and resulting population health risks associated with the exposure to heavy metals are neither new nor temporary concerns. The health implications of environmental crises that result from the pollution of our soils, the land and water systems, the air, food supplies etc. are no longer local. Recent catastrophes such as the Fukushima nuclear power plant accident and the COVID-19 pandemic are clear signs. As evidenced by more severe and frequent natural disasters, climate change is real and can have potential destabilization effects on toxic waste sites and increase the risks of exposure to hazardous chemicals. The events that impact one part of the world have major implications and ramifications in other parts. The might of a country is no longer sufficient enough to isolate it from a global environmental crisis, nor could any country or world leader control the global wind or water patterns. Therefore, wanting to only care about the people in one geographical area to the detriments of populations in other areas has become utopia when it comes to major environmental disasters. The double standard of having environmental protection laws in one part of the world, while allowing multinational corporations to exploit and destroy habitats in other parts for the well-being of the exploiter will only hurt everyone on the long-term.

Conclusions

There were 1340 Superfund sites in the U.S. as of October 9, 2024.[21] As detailed above, the communities played a vital role in the case of Superfund remediation in Pueblo, Colorado. Their strong involvement and advocacy for themselves, and their subsequent empowerment by the Governor of the State of Colorado certainly helped speed up the process and secure completion of a significant portion of the remediation in a record time of five years. This case study is evidence that a small group of determined people, regardless of their background or socio-economic status, can inform their citizens and inspire them to collectively stand up for themselves and partake in all aspects of a process that impacts their medical and socio-economic conditions.

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In final recommendation, environmental issues and the related potential public health implications are no longer local. The wind that blows over the African Sahara desert is known to pollute air on the east coast of the U.S. When the Fukushima nuclear power plant accident happened in Japan a few years ago, it was expected that the toxic wastes would impact the west coast of the U.S.; however, nobody expected this contamination to happen in less than six months. Climate change is real and global warming is occurring in many parts of the Earth; therefore, the future proliferation of tropical diseases such as malaria is not completely unforeseeable. Medical scientists should no longer accept to only address some specific health issues and downplay others. For instance, the world medical community came up with a vaccine against COVID in just months, depending on source reliability. Yet, the mosquito-vectored malaria has been destroying the lives of millions of people around the tropical world for centuries. There is no doubt that controlling mosquitoes in the tropics could remain a challenge, considering the living conditions in these parts of the world. However, it is surprising that a very effective drug against *Plasmodium* species, the pathogens of malaria, has yet to be discovered by the world medical and pharmaceutical scientists. The absence of sustained efforts to help develop good and reliable treatments against malaria could be problematic at some future point. The European Medical Society is now in position to reliably advocate for the establishment of steadfast international bodies of research scientists that can successfully safeguard the world populations against the health consequences of potential future epidemiological tragedies. Such action is timely and overdue, in the higher interests of humanity.

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