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REVIEW

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# Lung Disease in Central Appalachia: It's More than Coal Dust that Drives Disparities

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The population living in Central Appalachia is disproportionately impacted by lung disease. This is driven, in part, by occupational hazards and environmental exposures. However, it is more than coal dust that is driving the ongoing disparity of lung disease in the region. This review describes how the decline of the coal mine industry and subsequent rise of unemployment, poverty, and educational disparities have increased risk for worse pulmonary health outcomes in the region. Additional challenges related to healthcare access, substance use, cultural characteristics, and social capital are highlighted in their relation to pulmonary health within Central Appalachia. Lastly, the review describes strategies that hold promise to reduce regional health disparities. Several healthcare and community-centered initiatives are highlighted as successful examples of collaborative efforts working towards improving pulmonary health outcomes in the region. However, significant challenges related to social, economic, and environmental factors remain. Addressing these social determinants of health must be a paramount concern for healthcare, community and political leaders seeking to impact change and improve the health and well-being of this vulnerable population.

## INTRODUCTION

Central Appalachia, including Southwest Virginia, Eastern Kentucky, Southern West Virginia, Northeast Tennessee, as well as portions of Ohio and North Carolina, is a largely rural and mountainous region in the United States. The population living in Central Appalachia is disproportionately impacted by a wide range of health disparities, including lung disease. The burden of lung disease in Central Appalachia is driven, in part, by occupational exposure from underground and surface mines. At the peak of coal production and employment in the region, there were over 700,000 coal miners living and working in Central Appalachia [1]. Most of these coal miners worked in an era of inadequate workplace protections and many have developed a range of lung diseases due to their occupational exposures. The recent epidemic of progressive massive fibrosis in Central Appalachia illustrates that even with current workplace protections, ongoing exposure to respirable coal and rock dust has sig-

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Abbreviations: ARC, Appalachia Regional Commission; GOLD, Global Initiative for Chronic Obstructive Lung Disease; COPD, Chronic Obstructive Pulmonary Disease; CWP, coal worker's pneumoconiosis; CHIP, Children's Health Insurance Program; RAM, Remote Area Medical Volunteer Corps; POWER, Partnership for Opportunity and Workforce and Economic Revitalization; OUD, Opiate Use Disorder.

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nificant health impacts [2]. However, it is more than coal dust that is driving the ongoing disparity of lung disease in this region. The prevalence, morbidity, and mortality of lung disease in Central Appalachia far exceeds the burden of disease in other mining regions in the nation. The population in Central Appalachia faces interdependent social, economic, behavioral, and environmental challenges that contribute to the disproportionate burden of lung disease in the region. What follows is a description of the lung disease in Central Appalachia, the environmental and social determinants that impact the pulmonary health of the region, and strategies that hold promise to reduce regional disparities and improve health.

## BURDEN OF LUNG DISEASE

In 2017, The Appalachia Regional Commission (ARC) report on Health Disparities determined that the Years of Potential Life Lost, a measure of premature mortality, is 25% higher in Appalachia than in the rest of the US [3]. Disparities in outcomes for a range of pulmonary conditions contribute to this premature mortality.

In one study of Appalachians from Eastern Kentucky, nearly 1 in 5 adults (19.6%) aged 40 years and over met the criteria for the Global Initiative for Chronic Obstructive Lung Disease (GOLD) definition of chronic obstructive pulmonary disease (COPD) [4]. This prevalence rate is more than three times higher than national age-adjusted prevalence rates in the US (5.9%) [5]. COPD hospitalization rates are 39% higher in Appalachia than in the rest of the US. Central Appalachians' COPD mortality rates are nearly twice as high (78 per 100,000) than rates in the US (42 per 100,000) [6].

In addition to COPD, Central Appalachians face disparities in both the prevalence and mortality from coal worker's pneumoconiosis (CWP). Although often thought of as a disease of historical interest only, the incidence of CWP in the US has increased since the early 2000s [7]. Miners working in the coal fields of the Appalachian mountains have been shown to be particularly vulnerable to develop rapidly progressive and severe pneumoconiosis [8]. In 2014, 91% of counties in the US experienced mortality rates of < 1 death per 100,000 due to CWP; in comparison, several counties in Central Appalachia had CWP mortality rates as high as 43.5 per 100,000 [9].

Central Appalachians are additionally disproportionately burdened by lung cancer. Lung cancer rates for Appalachian men and women are nearly 25% and 8% higher than men and women living in the rest of the US, respectively [10]. In recent decades, lung cancer rates have been declining substantially among women in most of the US; however, Central Appalachia is the exception. Between 1990 and 1999, lung cancer deaths increased by 13% in Central Appalachia; while women in the rest of the US experienced a 6% decline in lung cancer deaths during the same time period [11].

## DUST IS ONLY PARTIALLY TO BLAME

Differences in dust exposure, including cumulative dust exposure, dust composition, and particle size, as well as host susceptibilities, can lead to a wide spectrum of coal mining-related lung disease [12]. Although CWP has historically been associated with coal dust exposure, there is increasing evidence that exposure to silica (quartz) is contributing to the disproportionate rise of lung disease in Central Appalachian coal miners [13]. In recent decades, the coal mines of Central Appalachia have thinner coal seams relative to the rest of the US. In these "low-coal" seams, mining typically involves cutting through rock above and below coal seams which leads to increased silica dust exposure [14]. A recent analysis of mean respirable coal dust concentrations collected by underground mine inspectors demonstrates a significantly higher geometric mean concentration of respirable silica in Central Appalachia (0.05mg/$m^3$) compared to the rest of the US (0.028mg/$m^3$) [15].

Both respirable coal and silica dust can have toxic effects in coal miners. COPD, including chronic bronchitis and emphysema, is independently associated with exposure to coal and silica dust [16]. Coal mine dust exposure, including both coal and silica dust, is also associated with a form of pulmonary fibrosis known as dust-related diffuse fibrosis [17]. Lung function impairment [18] and rapidly progressing lung disease [2] have been increasingly described in coal miners with relatively short mining tenures due to intense dust exposures. Coal mining-related exposures including silica dust and diesel exhaust are likely to account for recent analyses showing an association between coal mining and lung cancer [19].

Workplace protections have been enacted by the US federal government to mitigate the wide array of toxicities associated with coal mine dust exposure. The Federal Coal Mine Health and Safety Act of 1969 was enacted to "provide more effective means and measures for improving working conditions and practices in the Nation's coal mines in order to prevent death…and occupational diseases." Amongst the many important provisions in this act was the establishment of the federal permissible exposure limit for respirable coal mine dust. The exposure limit for respirable dust was initially set to 2.0 mg/$m^3$, but a more stringent dust limit was set when quartz content exceeded 5% within dust samples [20]. Dust exposure limits, in addition to other provisions within the Federal Coal Mine Health and Safety Act, were effective at reducing the intensity of coal mine dust exposures and subsequent development of occupational lung disease over the ensuing three decades. Despite these measures,

the incidence of coal mining-related lung disease in the US has increased since the turn of the century with Central Appalachians facing the highest burden of disease [21]. The worsening burden of lung disease in Central Appalachia despite workplace protections suggests that, in addition to further improvement in workplace conditions, other factors need to be considered to improve pulmonary health outcomes. The interconnected economic, social, behavioral, and environmental determinants of health that exist in Central Appalachia are critical factors contributing to the pulmonary disparity gap affecting this region.

## THE DECLINE OF THE COAL INDUSTRY AND THE RISE OF UNEMPLOYMENT AND POVERTY

The coal industry has played a central role in the Central Appalachian economy for much of the past century. Due to a combination of factors, including cheap natural gas (a competing fuel source for electric power production) and a regulatory environment that increased the cost of coal production/burning, demand for coal has declined since the early 2000s [22]. While demand for coal has decreased, the process whereby coal is mined has also transformed—with increased mechanization of coal mining, fewer coal miners are needed to mine the coal. This combination of decreased demand and increased mechanization has led to a dramatic decrease in the coal mine production and employment in the US. The peak level of US coal mine employment was over 850,000; whereas current US coal mine employment is now less than 50,000 [23]. Coal mine employment in Central Appalachia has declined more rapidly than in the rest of the US. In the last decade, coal mine employment in Central Appalachia has decreased from 35,408 (2010) to 16,361 workers (2019) [24]. Six out of the nine coal companies that filed for bankruptcy in the US in 2018-2019 were located in Central Appalachia [25].

The decline of the coal mine industry in Central Appalachia has had a far-reaching economic impact. This is in part due to the lack of economic diversification in the region; in 2005, coal mining comprised more than half of total employment in many Central Appalachian counties [22]. In large part due to this decline of coal mine employment, the region now faces a high concentration of "economically distressed" counties—which is defined by the ARC as a county that ranks in the highest 10% in the nation in unemployment rates and poverty rates and in the lowest in per capita income. Across the entire Appalachian region 78 counties are classified as economically distressed. Of these, 51 are located in Central Appalachia [26]. Twenty-one counties in Central Appalachia have at least double (28%) the poverty rate compared to the national average (14%) [27].

Several recent studies highlight how the high rates of unemployment and poverty in Central Appalachia are important factors contributing to pulmonary disparities. In the US, rural residence and poverty are independent risk factors for COPD amongst both smokers and non-smokers. Environmental exposures, nutritional status, low birth weight and childhood respiratory infections and lack of access to healthcare and health education all likely contribute to this disparity [28]. In another recent multinational study of nearly 10,000 patients, poverty was associated with impaired lung function even after accounting for age, smoking, history of asthma, other exposures, and prior infections [29]. Other downstream effects of unemployment and poverty, such as educational attainment, healthcare access, and tobacco use are discussed below.

## OPIOID CRISIS

The opioid crisis has disproportionally impacted the Appalachian Region, resulting in significantly higher overdose mortality rates in Central Appalachia compared to the rest of the US [30]. Opiate Use Disorder (OUD) is associated with a spectrum of pulmonary diseases beyond the classic association of respiratory depression. Such illnesses include increased risk of aspiration pneumonia from consciousness impairment or pulmonary edema and alveolar damage with heroin inhalation [31,32]. Intravenous drug users have been reported to have granulomatous pneumonias secondary to drug contaminants and more commonly can have pulmonary septic emboli secondary to endocarditis [31,32]. Pneumothorax is a potential complication of inhalational substance [32]. Beyond the individual morbidity and mortality is the loss of these (often working age) individuals from their families and communities.

The COVID-19 pandemic has further highlighted the opiate epidemic, in both the increased challenges of medical management of OUD and increased risk for contracting COVID-19 among persons with OUD. Many patients have had to travel further or have not been able to access treatment due to closure of substance use treatment clinics [33]. There has also been less access to acute care as hospitals have had to divert resources to acute care for COVID-19 patients and there have been less mental health resources due to overburdened healthcare centers [33]. Substance use experts have also seen a rise in relapses, potentially as people in recovery are forced into isolation and without social support systems [34]. Patients that suffer from OUD may also be at increased risk for COVID-19 due to a disproportionate reliance on informal sources for medical and COVID-19 information, an inability to maintain stable housing and meals, and an

increased risk for contracting and spreading COVID-19 since drug procurement and use generally involves social contact [35]. The US Department of Health and Human Services Office of Inspector General has generated a report that suggests that measures taken to address the COVID-19 pandemic (such as relaxed rules related to telehealth and opioid prescribing, reduced access to in-person screenings for opioid misuse and treatment facilities) may have contributed to the increases in opioid overdoses and deaths in several Central Appalachian states since the beginning of the pandemic [36]. The opiate epidemic not only contributes to increased risk and worsened severity of lung disease, but also exacerbates social and economic determinants of health in Central Appalachia.

## EDUCATION

Health and education are intrinsically linked, as good health is needed for educational achievement, and education achievement is an important factor contributing to good health. Recognizing this interplay, it is a formidable regional challenge that amongst adults aged 25 and older in Central Appalachia, 21.5% have not completed a high school degree. This is nearly double the US average. Only 14.1% of Central Appalachians hold a bachelor's degree or higher, which is less than half the US average [35]. The impact of educational disparities in Central Appalachia have wide reaching implications related to lung disease.

Low educational achievement is associated with poor health literacy: in a nationally representative sample, almost half of US adults who did not graduate from high school had low health literacy [37]. In a multivariable analysis of factors contributing to low health literacy, lower educational attainment was the strongest predictor of poor health literacy [38]. Low health literacy is a barrier to participation in lung cancer screening [39] and is associated with worse COPD outcomes [40]. Poor health literacy has also been linked to poor medication adherence, increased ED visits and increased hospital admissions [41].

Low educational attainment is also a risk factor for smoking and subsequent development of smoking related lung diseases. Low educational attainment is associated with daily smoking and nicotine dependence [42]. Individuals with less than a high school education have fewer quit attempts and are less likely to successfully quit smoking [43]. Lower education attainment is one of many factors in Central Appalachia that contributes to smoking rates, which are amongst the highest in the nation [6].

Recent data suggests some progress in reducing the educational disparity gap in Central Appalachia. The percentage of Central Appalachians aged 25 and older with less than a high school degree decreased by 3.6% in the last 12 years, compared to nationwide decrease of 1.7% overall [3]. Furthermore, the student-teacher ratio in Central Appalachia was 15, lower than the US national average of 16.5 [3].

## HEALTHCARE ACCESS AND QUALITY

Access to healthcare is dependent on numerous factors that range from whether an individual has health insurance coverage to less easily quantifiable factors such as the impact of family responsibilities, inability to miss work, or lack of transportation. In the last decade, the overall trend in health insurance coverage in Central Appalachia has been positive: Between the 2009-2013 and 2014-2018 periods, the rates of people without health insurance fell at least 8% in Central Appalachia [44]. The decrease in the uninsured was greater in two age groups in particular, children and those under the age of 35. The uninsured rate in Central Appalachia in the under-35 population was nearly 10% lower in 2014-2018 than in 2009-2013 [44]. This is largely due to programs designed to increase coverage including expansion of the Children's Health Insurance Program (CHIP) and provisions of the Affordable Care Act such as the young adult coverage extension that permits children to stay on a parent's health insurance plan until they turn 26 years old [44]. In addition, Kentucky, Virginia, and West Virginia have each implemented Medicaid expansion in the past decade. More than 500,000 Virginians have enrolled in Medicaid since the expansion was implemented in 2019 [45]. States in Central Appalachia that did not expand Medicaid (Tennessee and North Carolina) have had more limited primary care services and COVID-19 pandemic-related services. Underserved areas in these states have had less access to testing, fewer preparations, and greater financial strain on community centers and local health departments [46,47].

Despite these improvements, health insurance remains a challenge for many in the region. Nearly 15% of Central Appalachian residents aged 26-34 do not have health insurance coverage. As with many social determinants of health in the region, the divide is wider for those who live in rural areas where nearly 18% of residents aged 26-34 do not have health insurance coverage [44].

In addition to ongoing high rates of being under insured and not insured, Central Appalachians face additional healthcare access challenges related to geographic isolation, limited transportation options, and insufficient technology infrastructure. The physical distance required to travel from a patient's home to a healthcare facility is a well-recognized barrier to healthcare access [48]. This is especially relevant in Central Appalachia in which the mountainous topography has led to circuitous travel routes. Traveling to reach medical care in Central Appa-

lachia is further challenged by limited access to a personal vehicle; in Central Appalachia, more than 8% of the population do not have access to personal transportation [44]. Furthermore, only 0.5% of rural residents use public transportation because, when it is available, the systems are often limited to a single county or municipality which limit the destinations available to be reached without a car [49].

The COVID-19 pandemic led to a transformation in both healthcare regulations and practice structures that support digital accessibility to healthcare via telemedicine. This transformation has further highlighted a rural-urban "digital divide" in access to technology and internet capable of telemedicine visits. In Central Appalachia 1 in 5 households do not have a computer device, including desktop or laptop, smartphone, tablet, or other device) [44]. Only 67% of households have a broadband internet subscription that has bandwidth capable of video visits [33]. As telemedicine utilization has exponentially increased outside of Central Appalachia in 2020-2021, the impact of this digital divide on health disparities in Central Appalachia remains to be seen.

The number of healthcare providers is significantly lower in the Central Appalachian region than the nation as a whole. For example, the supply of primary care physicians in Central Appalachia is 32% lower than the national average [49]. This is compounded by a reduced supply of subspecialty physicians in the region; the supply of subspecialty physicians (110 per 100,000) is 28% lower than the national average (153 per 100,000 population) [50]. Limited access to pulmonology subspecialists in Central Appalachia necessitates that management of lung diseases is largely dependent on primary care providers [51]. There are several examples of how this reliance on primary care providers might negatively impact pulmonary health outcomes in the region. One such example is in pulmonary rehabilitation, an essential component of guideline-based therapies for many chronic lung diseases including COPD. Although recent studies have shown the feasibility and benefit of pulmonary rehabilitation in rural Appalachian communities [52], underutilization in Central Appalachia is in part because of lack of awareness of benefit by primary care providers and limited access to specialty programs in rural areas [53].

There are many examples of community organizations in Central Appalachia, including federally qualified health clinics and free medical clinics that serve vulnerable populations who lack health insurance and could not otherwise afford or access healthcare. One such example is the Health Wagon [54] in Southwest Virginia. The Health Wagon is a non-profit mobile clinic that provides free primary and subspecialty care to patients of geographically isolated regions of Central Appalachia. The clinic's medical director is a pulmonologist and the mobile clinic is outfitted with both pulmonary function testing and x-ray testing. Another example is the Remote Area Medical (RAM) Volunteer Corps [55] which held more than 60 mobile clinic events in and around Central Appalachia each year. Volunteer dentists, physicians, nurses, and other healthcare professionals offered free on-site care through the RAM program to tens of thousands who have few other options. In 2020, RAM did not assemble to offer support, which was partially due to COVID-19 social distancing restrictions, but also due to a greater number of Virginians enrolled in Medicaid (following Virginia's expansion in 2019) [56]. Although these community organizations can provide some safety-net care to a vulnerable population, they highlight the significant healthcare access gaps that Central Appalachians continue to face despite increased insurance availability through Medicaid expansion and the Affordable Care Act.

## SOCIAL AND COMMUNITY CONTEXT

Social and community context can impact individual health outcomes through social capital and cohesion, neighborhood attributes, and cultural attitudes [57]. Researchers have suggested that more social cohesion and capital can improve individual health outcomes by providing opportunity to mitigate poverty, disparity, and social exclusion [58]. Qualitative studies have identified aspects of Appalachian culture that build social capital and foster social cohesion, which are generally protective for health outcomes. Men and women in focus groups interviewed by Coyne et al. (2006) vocalized a strong sense of place, deep family ties, and strong faith in God as attributes of many rural southern West Virginians; all of these might improve health outcomes [59]. There may be also Appalachian cultural beliefs that increase risk for lack of early healthcare intervention or poor health behaviors. Religious beliefs may conflict with medical care, as some patients turn exclusively towards divine help, believing that this may be enough [59]. Deep ties to the community may become exclusionary to outsiders leading to concerns about foreign-born or "outsider" physicians being untrustworthy [59]. There is also a high turnover rate of medical providers in the region, likely making it even more difficult to build trust [59]. Additionally, Coyne's team found that there was concern that family problems would become public knowledge if help was sought from medical providers [59]. There is a risk of interpreting Appalachian beliefs as "odd" or that individuals' religious beliefs as evidence of fatalism. However, more modern studies have found that Appalachians consider both their faith and counseling from medical professionals [60]. Ultimately, medical providers will need support to learn about Appalachian culture and build on the present social cohesion to facilitate successful medical care.

Central Appalachia lacks social capital on a political scale that impedes its ability to build healthier communities. Lee County, Virginia is an example of this, as it is closer to eight other state capitals than it is to its own capital in Richmond [61]. Distance from a state capital is associated with reduced accountability [62]. For example, newspapers give more coverage to state politics when more readers are closer to the capital; voters who live further from the capital are less knowledgeable and interested in state politics, they also have lower turnout for state elections [62]. This pattern then results in less funding from programs that might build community and healthier behaviors [62]. Tobacco use is a good example of how this impacts lung disease in Central Appalachia. Tobacco crops have been a major source of income in this region and tobacco has been normalized into the culture [63]. Higher taxes on cigarettes are recognized as a successful strategy in achieving major reductions in smoking among some high-risk populations [64] and the tobacco industry has spent significant resources to maintain low prices, particularly in low-income communities [65]. For example, tobacco taxes are significantly lower in Virginia (0.60 cents per pack) as opposed to the District of Columbia ($4.50 per pack) [66,67]. This low tax rate results in less funding for tobacco control programs and less access to health information about tobacco and is associated with greater use [64]. There are also higher rates of comorbid behavioral health disorders associated with higher tobacco use, likely increasing risk for smoking and tobacco use [63,68]. The higher prevalence of smoking in these regions contributes to the disparity in COPD and lung cancer mortality [63,68]. Among those who are interested in quitting, there is more social stigma in these areas, which can decrease opportunities to engage in the community and impede smoking cessation efforts [69]. Simply put, tobacco use has propagated across generations in Central Appalachia, partly because its citizens are more isolated from resources and lacking in social capital.

## FUTURE DIRECTIONS

Healthcare-centered initiatives are a critical component of collaborative efforts working towards improving pulmonary health outcomes in Central Appalachia. Both West Virginia University and University of Virginia have established Project ECHO programs directed at expanding access to university pulmonary expertise for rural healthcare providers [70,71]. Stone Mountain Health Services is a network of 13 federally qualified health clinics in Southwest Virginia, including two respiratory care clinics. The University of Virginia has partnered with Stone Mountain Health Services to develop a pulmonary telemedicine program, a remote pulmonary rehabilitation program and a smoking cessation program [72]. Catholic Health Initiatives has developed the first mobile lung cancer screening unit (motor coach equipped with a CT scanner) in the nation to improve access to lung cancer screening [73]. These approaches hold promise to improve access and quality of healthcare directed at those at risk for poor outcomes from lung disease.

State leaders could expand access to care in the Appalachian region by increasing the size and scope of rural training programs. Physicians working in Central Appalachia are mostly graduates of medical schools in or near the region; therefore, more training programs in the region may help alleviate the area's health professional shortages [74]. A small but growing number of health professional schools and residencies around the US have recognized this need and developed rural-specific training programs [75]. University of Kentucky, West Virginia University, and Eastern Tennessee State University Quillen College of Medicine are examples of such medical schools, with tracks that supply mentorship, clinical experience, and education designed to prepare future clinicians to provide high quality care in rural communities. Increasing funding to expand these types of programs, as well as to motivate and to facilitate trainees to serve these regions long-term will be important for their sustainability. The National Health Service Corps and Nurse Corps have successfully brought and retained physicians, nurses, nurse practitioners, and physician assistants in rural and at-need communities using support-for-service programs [76]. Loan repayment and direct financial incentive programs have demonstrated the most success [76]. However, healthcare-centered approaches are limited in their effectiveness at addressing many other social determinants of health that drive pulmonary health disparities in the region.

Community and political leaders seeking to improve the health and well-being of Central Appalachians face deep rooted social, economic, behavioral, and environmental challenges that do not have easy solutions. Developing a long-term, sustainable strategy to increase economic diversity, enhance job training, create new jobs, and attract new sources of investment is a formidable task [77]. Given Central Appalachia spans dozens of counties and multiple states, coordinating local and regional efforts is essential. In 1965, the federal government assembled the Appalachian Regional Commission (ARC), a federal-state-local economic partnership agency to strengthen communities, upgrade infrastructure, and build economic growth in the Appalachia Region. The ARC analyzes vulnerabilities and opportunities for the region, investing agency resources in projects that retrain people of struggling counties to then bring that county out of a distressed state [78]. The ARC's recent quantitative and qualitative analysis of how best to cultivate economic resilience in Central Appalachia has led to eight recommended best

**Table 1. Eight Best Practices for Growing Economic Resilience in the Appalachian Region [77]**

1. Invest in education, technology, infrastructure and broadband
2. Engage the community over the long term
3. Create communities where people want to live
4. Grow youth engagement and next-generation leadership
5. Identify and grow the assets in the community and region
6. Build networks and foster collaboration
7. Move multiple sectors forward for economic development and grow value chains
8. Cultivate entrepreneurs and develop resources for business start-ups

practices (Table 1) [77]. The ARC has been particularly focused in investing in skill development and work force training programs for citizens, with the goal of expanding job opportunities in science, technology, engineering, and healthcare [79]. The ARC's INSPIRE Initiative has awarded $9.4 million to projects in Appalachia for the added goal of addressing the substance abuse crisis by expanding workforce entry and re-entry [80].

There are many examples of impactful collaborative programs that are working to improve the social, economic, and environmental challenges facing Central Appalachia. The United States Economic Development Administration and the ARC are collaborating with Central Appalachian Communities through the federal Partnership for Opportunity and Workforce and Economic Revitalization (POWER) initiative. The POWER initiative has thus far invested 238 million dollars to support the implementation of nearly 300 projects aimed at improving economic opportunities, promoting a ready workforce, building infrastructure and attracting new sources of investment [81]. Another example of successful community-drive initiatives is The Reclaiming Appalachia Coalition, a regional collaboration that seeks to spur mine reclamation projects throughout Central Appalachia that are responsive to community needs and accelerate the growth of new sustainable sectors. In 2019-2020, this coalition has funded over 31 million dollars into projects in Appalachia, creating an estimated 400 jobs [82].

## CONCLUSION

To eliminate healthcare disparities in Central Appalachia, it is necessary to create policies that improve environmental quality and reduce occupational hazards that are unique to these communities [83]. However, it is clearly more than coal dust that is driving disparities in Central Appalachia. Rural health programs and interventions, developed through an iterative, community-based process, have demonstrated success in Central Appalachia. Addressing the social determinants of health must be a paramount concern for healthcare, community, and political leaders seeking to impact change and improve the health and well-being of this especially vulnerable population.

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