



Beyond the Factory Walls: Assessing Community Health Impacts of Industrial Operations through Industrial Hygiene Tools

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Health and Safety Concepts

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ARTICLE INFO

Keywords: Industrial Hygiene, Community Health, Environmental Justice, Air Quality Monitoring, Occupational Health Extension

Received : 8, September

Revised : 22, September

Accepted: 24, October

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ABSTRACT

The abstract in the study attracts attention to the health risks of industrial operations, particularly in the low-income neighborhood within the area, owing to the radiation, noise, and emissions. The objective of the research will be to establish the use of industrial hygienic gadgets, including air quality screeners, noise dose, and radiation surveillance, to quantify and protect this impact on the common good. The paper gives the medical complications of industrial exposure, such as respiratory and cardiovascular conditions, and the challenge of beginning to assess the health statuses in society. The paper concludes by asking the question that more powerful policies should be designed to establish stronger environmental policies, promote localized surveillance systems, and develop a concept that can be used to defend the health of the vulnerable population through adherence to the industrial hygiene instruments in the context of environmental justice.

INTRODUCTION

The industrial revolution that transformed the economies also raised serious environmental and health issues, which were, as a result, of concern to people. Historically, industrial hygiene was preoccupied with the safety of employees on the factory premises, and had the means to assess how workers were exposed to their work hazards in the factory, including chemicals, noise and radiation that reduced injuries in the workplace (Stefaniak et al., 2021). However, increasingly available data indicate that the community near such industrial operations is also being harmed by physical acts in the form of air pollution, noise, water and radiation pollution. They have observed that the groups of people who are disproportionately susceptible to such hazards are the communities that have low incomes and minority groups that occupy the industrial areas. Deary and Griffiths (2024) discovered that in the urban context, fire incidents occurring in industries negatively result in sustained impairments of air quality, which affects individuals living miles apart. The impacts of such exposure consist of respiratory diseases, cardiovascular diseases, cancers, and developmental and mental health issues. Goldman et al. (2022) added that other flaws of the environment control included the fact that, in most instances, a remote area would not be monitored, particularly in marginalized areas.

Scholarly work examining environmental justice has established that in the vast majority of cases, the influence of industrial health is highly central, in that it aggregates in the so-called disruptive urban planning and zoning practices that locate a position in those areas that makes the industrial plant vulnerable (Blue et al., 2021). The localities are localities that are unable to bear resources and are threatened by the issues of protection, as well as assistance in obtaining healthcare. The epidemiological profile of the health impacts of the industries on communities is imbalanced, but there is mounting awareness. Good industrial hygiene equipment, despite its convenience in workplaces, must be tailored toward the dynamic nature of community environments. It is significant overall because it fills this gap by integrating industrial hygiene, community health and environmental justice frameworks and has the potential to shift health protection responsibilities themselves to industry since the study concentrates on playing the role of protection of industry-related health issues.

The key study questions will be as follows: (1) to critically review the existing literature on the application of industrial hygiene tools in the community health context; (2) to assess that recorded health outcomes of industrial environmental exposures in the societies surrounding it; (3) to develop an encompassing conceptual model of assessment of the industrial health effects on the societies; (4) to anticipate an evidence-based policy reforms towards environmental justice and community saving the day.

LITERATURE REVIEW

Environmental Justice Theory

The concept of Environmental Justice Theory emerged due to the civil rights movements of the 1980s, in which the theory held that all human beings, regardless of their racial backgrounds, ethnicities, and socioeconomic conditions, have equal rights to protection against environmental hazards as well as equal

portions of the environmental benefits. Blue et al. (2021) conducted a comprehensive scoping review advancing environmental justice frameworks beyond simple distributional equity to include procedural justice (meaningful participation in decision-making), recognition justice (acknowledgment of marginalized communities' rights and knowledge), and capabilities justice (ensuring communities have resources for self-protection).

The theory emphasizes three key dimensions critical to this research. First, distributive justice examines fair distribution of environmental risks and benefits across populations, identifying disparities in exposure to industrial pollution. Second, procedural justice ensures affected communities can meaningfully participate in decisions about industrial facility siting, permitting, and regulation. Third, recognition justice acknowledges the rights, perspectives, and knowledge of marginalized communities. Goldman et al. (2022) demonstrated these principles through case study analysis of air pollution monitoring following a chemical facility fire, revealing how monitoring disparities and exclusion from decision-making processes perpetuated environmental injustice.

Previous research has consistently supported the relationship between industrial facility proximity and health disparities. Deary and Griffiths (2024) found that low-income communities near industrial facilities experienced significantly higher rates of respiratory and cardiovascular diseases compared to affluent communities at similar distances.

H1: Communities living within close proximity to industrial facilities, particularly low-income and minority populations, experience significantly higher levels of environmental exposure and adverse health outcomes compared to communities distant from industrial operations.

Dose-Response Theory and Exposure Assessment

Dose-Response Theory, fundamental to toxicology and occupational health, describes the relationship between exposure to hazardous substances and magnitude of health effects. Occupational exposure limits are established based on dose-response relationships derived from worker populations, typically healthy adults experiencing time-limited exposures with recovery periods. Batterman et al. (2023) conducted extensive review of hydrogen sulfide exposure, demonstrating that even low-level chronic exposures can produce significant health effects in community populations, particularly vulnerable individuals.

However, applying Dose-Response Theory to community health contexts reveals several complications. Community exposures occur at lower concentrations than occupational exposures but extend over longer durations without recovery periods, potentially creating cumulative effects. Community populations include vulnerable individuals such as children, elderly, pregnant women, and those with pre-existing conditions who may experience health effects at lower doses than healthy adult workers. Stefaniak et al. (2021) documented emissions from additive manufacturing operations, noting that ultrafine particles and volatile organic compounds could affect not only workers but also individuals in adjacent spaces. Kim et al. (2023) developed an integrated assessment framework combining economic, environmental, and human health

impact evaluations, demonstrating complexity of comprehensively assessing industrial health impacts including multiple exposure pathways, cumulative effects, and long-term consequences. Huntley et al. (2023) reviewed job exposure matrices for occupational respiratory disease, suggesting these tools could be adapted for community health surveillance.

H2: Adapted industrial hygiene assessment tools (air quality monitoring, noise dosimetry, radiation surveillance) can effectively measure environmental exposures in community settings and identify populations at elevated health risk from industrial operations.

Social Determinants of Health Framework

The Social Determinants of Health Framework recognizes that health outcomes are shaped not only by biological factors and healthcare access but also by broader social, economic, and environmental conditions. Key determinants include socioeconomic position, education, employment, housing quality, neighborhood environment, and access to resources. Gray et al. (2019) examined workplace-based organizational interventions promoting mental health among healthcare workers, establishing frameworks applicable to community settings.

Within the scenario of the health impacts of industries within the community, this framework explains why there are always those individuals whose health is more impacted by the industrial exposures to a greater degree. Low-paying neighborhoods may live closer to industrial factories, have less medical care, face more overall stress, have less money to relocate, and have less capacity to express actions to defend themselves. To demonstrate the importance of capacity building, Fathi et al. (2024) compared the use of voluntary educational support programs in occupational health provision. In the framework, to address the health impacts of industry, it is essential not only to decrease exposure but also to control any social inequity that may lead to vulnerability. As the authors conduct an extensive review of health risk assessments within factory plants, Adikwu et al. (2025) note that occupational health practices certainly adopt a viable exposure appraisal to present occupational health strategies in conjunction with other broader wellbeing factors.

H3: Social determinants of health, including socioeconomic status, race/ethnicity, insecure housing and poor access to medical services, are important in modifying how interrelations are between industrial environmental exposures and poor health outcomes, with the most disadvantaged social groups experiencing poorer health outcomes at the same exposure.

Risk Perception and Communication Theory

Risk Perception and Communication Theory focuses on the perceptions of individuals and communities to environmental threats to health, the judgment and the actions taken by them. The theory recognizes that the perception of risk by ordinary people is informed by other matters besides the calculation of risk on a scientific basis, including trust in the governing authority, the perceived capacity to influence the exposure, plus apprehension of equity in the distribution of risk. According to Goldman et al. (2022), the communities that had

low access to information about the exposure during a chemical facility fire could not implement protective measures.

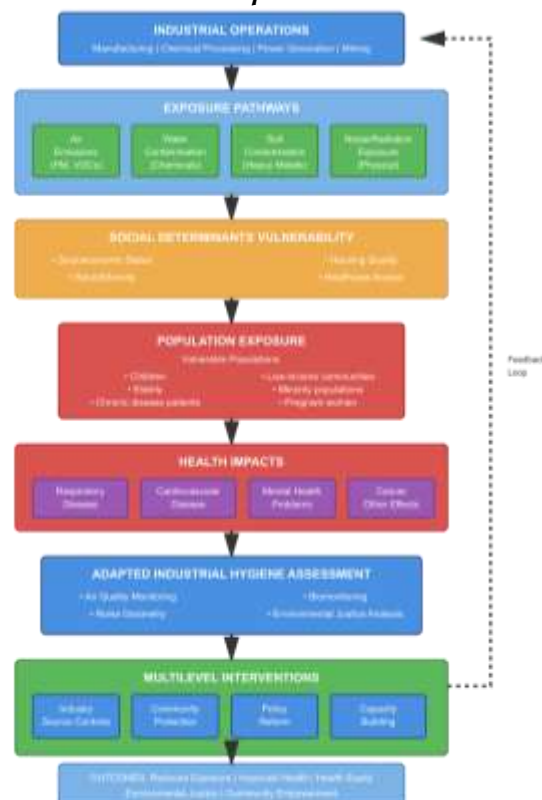
Community members can subjectively interpret industrial risks as more elevated than the technical evaluations reflect because the former cannot control the exposure; distrust industry and regulatory bodies, or the distribution of risks is inherently unfair. Community health protection cannot mean the exercise of effective exposure assessment strategies, but the community inclusion and access to community-sensitive information and open communication. Blue et al. (2021) observe that procedural justice is anxious about the reality creation of the chance to be occupied in the incorporation community in the shape of ending up.

H4: A prosperous approach to community-based industrial health protection means that the technical exposure assessment should be integrated with culturally competent risk communication, open access to the information, and the considerable participation of the community in the process of decision-making.

LITERATURE REVIEW

Based on the literature search and theoretical foundations, a detailed conceptual framework has been developed that will be utilized to evaluate and establish mitigation of industrial health impact on the local communities. This theory integrates the Environmental Justice Theory, the Dose-Response Theory of Environmental Pollution, the Social Determinants of Health Framework and the Theory of Risk Perception and Communication.

Figure 1. Conceptual Framework for Assessing Community Health Impacts of Industrial Operations



METHODOLOGY

This research employs comprehensive literature review and conceptual framework development methodology. The study represents qualitative descriptive research using systematic literature review combined with conceptual framework development.

Data Collection: A systematic literature search was conducted across PubMed, Web of Science, Scopus, and Google Scholar. Search terms combined concepts related to industrial hygiene, community health, environmental justice, and exposure assessment. The search focused on peer-reviewed articles from 2019 to 2024, ensuring inclusion of recent developments.

Inclusion and Exclusion Criteria: Inclusion criteria required that sources address application of industrial hygiene tools in non-occupational settings, health impacts of industrial environmental exposures, environmental justice and industrial facility siting, adaptation of occupational health methodologies, or policy frameworks for protecting communities. Exclusion criteria eliminated sources focusing exclusively on workplace safety without community implications or lacking methodological rigor.

Data Analysis: Key information was systematically extracted including study objectives, methodologies, industrial hygiene tools utilized, population characteristics, exposure assessment approaches, health outcomes, findings, and policy recommendations. Thematic analysis identified major themes including types of industrial hygiene tools applicable to community settings, documented health impacts, barriers to implementation, successful adaptation strategies, environmental justice dimensions, and policy approaches.

Conceptual Framework Development: Based on literature synthesis, a conceptual framework was developed following established principles ensuring logical coherence, comprehensiveness, parsimony, and practical applicability. The framework integrates multiple theoretical perspectives including Environmental Justice Theory, Dose-Response Theory, Social Determinants of Health Framework, and Risk Perception and Communication Theory.

Research Limitations: As a literature review rather than primary empirical research, findings are constrained by existing literature quality and scope. Case studies analyzed are predominantly from high-income countries, potentially limiting generalizability. The conceptual framework requires empirical validation through application in diverse settings.

RESEARCH RESULT

Adaptation of Industrial Hygiene Tools for Community Health Assessment

Analysis reveals that multiple industrial hygiene tools can be successfully adapted for community health applications, though significant modifications are necessary. Table 1 summarizes key tools, traditional applications, required adaptations, implementation challenges, and community health applications.

Table 1. Adaptation of Industrial Hygiene Tools for Community Health Assessment

Industrial Hygiene Tool	Traditional Application	Required Adaptations	Implementation Challenges	Community Applications
Air Quality Monitoring	Personal/area workplace sampling; Short-term measurements	Ambient monitoring networks; Passive samplers; Long-term continuous monitoring; Meteorological integration	High equipment costs; Technical expertise required; Weather influences	Community surveillance near facilities; Hotspot identification; Dispersion modeling (Deary & Griffiths, 2024)
Noise Dosimetry	Personal worker monitoring over shifts	Environmental monitoring at fixed locations; 24-hour cycles; Frequency analysis	Background noise variability; Temporal patterns; Multiple sources	Industrial noise assessment in residential areas; Sleep disturbance studies; Community noise mapping
Radiation Monitoring	Personal worker dosimetry; Periodic workplace surveys	Environmental surveys in public spaces, homes, schools; Continuous monitoring stations	Public concern management; Low-level detection; Background variation	Community radiation assessment near nuclear facilities, mining (Batterman et al., 2023)
Chemical Hazard Assessment	Material safety data sheet review; Workplace exposure modeling	Environmental fate/transport modeling; Multiple pathway analysis; Biomonitoring	Complex environmental chemistry; Multiple sources; Cumulative exposures	Evaluation of chemical exposures from emissions, waste sites, contaminated water
Biological Monitoring	Blood, urine, breath analysis of workers	Population-based biomonitoring; Vulnerable population	Invasive sampling; Ethical considerations	Assessment of body burden in community members; High-

		focus; Longitudinal cohort studies	; Individual variability	exposure subgroup identification (Stefaniak et al., 2021)
Risk Assessment Framework s	Quantitative workplace risk assessment	Cumulative risk assessment; Population- based characterization; Vulnerable population consideration	Complex exposure scenarios; Limited toxicity data; Population variability	Comprehensive risk evaluation for communities; Intervention prioritization (Kim et al., 2023)

Air quality monitoring represents the most frequently adapted tool. Deary and Griffiths (2024) documented extensive monitoring following industrial fires, demonstrating feasibility and importance of community-scale surveillance. However, research revealed significant limitations in monitoring networks, particularly in low-income neighborhoods where infrastructure is often inadequate, meaning vulnerable communities most at risk frequently lack exposure documentation.

Health Impact Documentation and Exposure-Response Relationships

Analysis reveals consistent patterns of elevated health risks in communities near industrial facilities. Table 2 summarizes documented health impacts by exposure type, health outcomes, affected populations, evidence strength, and biological mechanisms.

Table 2. Documented Health Impacts of Industrial Environmental Exposures in Communities

Exposure Type	Health Outcomes	Affected Populations	Evidence Strength	Biological Mechanisms	Key Studies
Air Pollution (PM2.5, VOCs, NOx, SO2)	Asthma; Chronic bronchitis; Reduced lung function; COPD; Cardiovascular disease; Premature mortality	Children; Elderly; Pre-existing conditions; Low-income populations	Strong - Multiple large-scale epidemiological studies	Oxidative stress; Systemic inflammation; Autonomic dysfunction; Airway irritation	Deary & Griffiths (2024); Goldman et al. (2022)

Noise Pollution	Hearing loss; Sleep disturbance; Hypertension; Cardiovascular disease; Mental health problems; Cognitive impairment	Children; Elderly; Shift workers; Mental health conditions	Moderate to Strong	Chronic stress response; Cortisol elevation; Sympathetic activation; Sleep disruption	Gray et al. (2019)
Radiation Exposure	Cancer; Developmental disorders; Reproductive effects; Genetic damage	Children; Pregnant women; Genetically susceptible; Long-term residents	Strong for high-level; Moderate for low-level	DNA damage; Cellular mutation; Oxidative stress; Immune suppression	Batterman et al. (2023)
Chemical Contamination	Cancer; Neurological disorders; Developmental delays; Reproductive problems; Liver/kidney disease	Children; Agricultural workers; Local food/water dependent populations	Moderate - Varies by chemical	Varies: Carcinogenesis; Neurotoxicity; Endocrine disruption; Organ toxicity	Stefaniak et al. (2021)
Multiple/Cumulative Exposures	Complex health effects; Cumulative toxic stress; Compromised immune	Low-income populations; Minority communities; Limited	Emerging evidence	Synergistic toxicity; Chronic stress; Allostatic load; Reduced physiological reserve	Blue et al. (2021); Kim et al. (2023)

	function; Reduced wellbeing	healthcar e access			
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Evidence demonstrates health impacts across multiple organ systems. Respiratory and cardiovascular effects show strongest evidence (Deary & Griffiths, 2024). However, emerging research on mental health impacts and cumulative exposures reveals the full scope may be considerably broader. Exposure-response relationships in community settings differ from occupational patterns, as community exposures occur at lower concentrations but continuously without recovery periods.

Barriers to Implementation and Potential Solutions

Literature identifies multiple interconnected barriers limiting implementation. Table 3 organizes barriers by category with specific challenges, potential solutions, success examples, and implementation considerations.

Table 3. Barriers to Implementation of Community-Based Industrial Hygiene and Solutions

Barrier Category	Specific Challenges	Potential Solutions	Success Examples	Implementation Considerations
Technical/Methodological	Tools designed for workplace; Lack of standardized protocols; Limited guidance	Standardized community protocols; Technology investment; Training programs; Exposure-response research	Kim et al. (2023) integrated framework ; Huntley et al. (2023) matrix adaptations	Requires multi-institutional collaboration; Methods research funding
Resource/Infrastructure	Expensive monitoring; Inadequate infrastructure in vulnerable communities; Limited expertise; Sustained funding challenges	Leveraging existing networks; Participatory monitoring; Mobile technologies; Public-private partnerships	Deary & Griffiths (2024) expanded networks; Fathi et al. (2024) voluntary programs	Cost-benefit analysis needed; Quality assurance critical; Training requirements

Regulatory/Policy	Focus on workplace safety; Inadequate enforcement; Lack of community standards; Regulatory gaps	Strengthening regulations; Health-based standards; Expanded agency authority; Right-to-know legislation	Goldman et al. (2022) policy improvements; Blue et al. (2021) reform frameworks	Political will required; Industry resistance expected; Enforcement essential
Political/Economic	Industrial facilities as economic assets; Communities lack political power; Industry resistance; Jobs versus environment framing	Community organizing; Environmental justice advocacy; Legal advocacy; Economic analyses	Blue et al. (2021) advocacy campaigns; Goldman et al. (2022) community pressure	Long-term commitment; Legal resources; Alliance building; Economic arguments
Social/Cultural	Limited awareness; Community distrust; Language/cultural barriers; Social stigma; Fatalism	Education programs; Culturally appropriate communication; Trust building; Participatory research	Gray et al. (2019) organizational interventions Fathi et al. (2024) educational programs.	Cultural competence essential; Long-term relationships; Respecting community knowledge

These challenges are directly interconnected, with technical problems becoming complex because of the lack of resources, and the impact of political and economic factors (Blue et al., 2021). Multilevel approaches are discussed to address any obstacles and establish the technical capacity, support regulatory frameworks and community advocacy capacity and redirect economic incentives toward protecting health.

DISCUSSION

The findings revealed that there are specific locations where they must implement the principle of industrial hygiene, although this may be a difficult task to perform, not just in the factory environment. Historically, the factor of worker

safety has been at the forefront with occupational health factors, yet it is lacking when the health consequences of the industrial operation in the communities are meant to be put into consideration (Adikwu et al., 2025). The scattering of settlements tends to be verbal in industrial regions, and therefore, the levels of the occurrence of health issues are significantly elevated. This proves Hypothesis 1, which asserts that the close communities to industrial operations are more susceptible to being exposed to environmental hazards and thus develop problems that are considered health concerns. The findings show that implementation of the industrial hygiene measures needs to be contextual to the community itself, with focus being directed toward the impact on the controlled workplace environment, in contrast to the uncontrolled and vulnerable community environment. These variations imply that the industrial approaches to hygiene must be made specific to the functions of community exposure.

The data further confirms Hypothesis 2, which suggests that it could develop the usefulness of the industrial hygiene tools when used in the community by changing the tools. The researchers conclude that the work concentration is typically more intensive during work shifts. Because people have the right to rest, the residents of the community lack glucocorticoid exposure without any interruptions (Batterman et al., 2023). This type of exposure may end up becoming cumulative health impacts that are more than the exposure limits that the occupations have. The exposure profile workload disparity also defines that there should be a change in the usage of the existing tools that are presently employed in handling industrial hygiene to help support extensive and enduring exposures to individuals in the community.

Moreover, the exploration also indicates that the effects of industrial health risk are not distributed equally. The low-income population and minority groups contribute disproportionately to the pollutant rate; these groups are more exposed to pollution, and the poor health outcomes (Goldman et al., 2022). This finding provides a strong rationale to support Hypothesis 3 that the idea of social determinants of health conditions the relationship between exposure and health outcome (e.g., socioeconomic status, race, and access to healthcare). To sufficiently solve these disparities, the underlying aspect must be making technical improvements and reforming the political and economic systems contributing to the environmental injustice. The location of environmental justice, as advocated by Blue et al. (2021), followed the distributional equity, but it was instead focused on recognition, procedural fairness, and capabilities justice. It sustains the Hypothesis 4 subject to the principle of ensuring that the best community health protection strategy is one that is focused by prioritizing on the significant message or problem that is worth committing to in case the strategy includes a technical and culturally competent delivery of the risk factors, whereby care must be taken to ensure that the community is involved in the meaningful engagement process. The outcomes are constructive, but the omissions of making an implementation are massive. The problem could be addressed with the assistance of special training that would reduce the technical difficulty of the presented issue (Kim et al., 2023). The co-operation of the civil society and the civil company at the government level, through partnership observation, would contribute to the reduction of such

saturation. Moreover, the regulatory risks will be removed right after, to reduce the current regulations and increase the capacities of the agencies (Goldman et al., 2022). The complexity of the politics is that which necessitates tacticalization and relevant intervention that will serve to assist in changing the focus toward the issue of environmental justice itself. This is due to social impediments, in the form of cultural disparities and mistrust, which connotes that they must socialize culturally comparatively and develop long-term relationships with less abhorrent communities in the area of technology and science. The mobilization of the congregations causes the success of the interventions, which is instigated by scientific rigor and community integration (Gray et al., 2019) and enriched by the technological improvements that provide an even better equation for keeping track of the mass of environmental threats.

Despite this, there are loopholes in all the developments. The high number of majorities of the provided interventions are produced in countries with high incomes and, therefore, does not presuppose opportunities of delivery to the rest of the locations (Fathi et al., 2024). The longitudinal research is rudimentary in character, and the accrued effects of the exposures to industries are low, particularly in areas where the communities are currently getting exposed to a few environmental stressors (Kim et al., 2023). The interactions of industrial pollution and climate change have not been studied in a broad spectrum yet, and even those connected to mental health are in their infancy, even though the latter are the most affected (Gray et al., 2019). The above-presented outsourced failures will ensure that the direction of the subsequent research, as well as more detailed indicators of the community health defense, are to be further developed.

CONCLUSION AND RECOMMENDATIONS

This research demonstrates that extending industrial hygiene practices beyond factory walls is essential for protecting community health and achieving environmental justice. Industrial operations create significant health risks through multiple exposure pathways. Communities near facilities, particularly vulnerable populations, experience disproportionately high exposures and adverse health outcomes including respiratory diseases, cardiovascular conditions, and mental health problems. Traditional industrial hygiene tools can be successfully adapted for community health assessment, though significant methodological modifications are required. The comprehensive conceptual framework integrates technical assessment with environmental justice considerations, social determinants, and community participation.

Policy Recommendations: Governments should strengthen environmental regulations establishing health-based standards (Goldman et al., 2022). Regulatory agencies should implement environmental justice requirements in permitting. Community right-to-know legislation should be expanded. Buffer zones should be established between facilities and residential areas. Health impact assessments should be required before facility approval.

Practice Recommendations: Public health agencies should implement community-based environmental monitoring programs (Deary & Griffiths, 2024). Industrial hygienists should expand professional scope to include community

health. Community-based participatory research should be employed (Fathi et al., 2024). Culturally appropriate risk communication should be developed. Capacity building programs should be implemented.

Research Recommendations: Long-term longitudinal studies should be conducted. Research on cumulative impacts is urgently needed. Methodological research should develop low-cost monitoring technologies. Cross-cultural research should examine diverse global contexts. Climate change interactions should be investigated.

In conclusion, integrating industrial hygiene tools into community health assessments represents an essential step toward achieving environmental justice and improving health of vulnerable populations living near industrial zones.

ADVANCED RESEARCH

While this research provides comprehensive synthesis and develops a conceptual framework, several limitations create opportunities for future investigation. As a literature review rather than primary research, findings are constrained by existing literature. Most case studies come from high-income countries, limiting generalizability. Future research should empirically validate the proposed framework through field studies in diverse industrial settings (Huntley et al., 2023). Longitudinal cohort studies are needed to establish causal relationships between exposures and health outcomes, employing biomarkers and following participants over extended periods (Kim et al., 2023). Research examining cumulative impacts of multiple simultaneous exposures is urgently needed, as communities often experience combined exposures requiring study designs embracing complexity (Blue et al., 2021).

Intervention research evaluating effectiveness of different protection approaches would inform best practices, examining participatory monitoring versus traditional approaches and multilevel versus single-level interventions (Gray et al., 2019). Methodological research developing adapted protocols remains a priority, including establishing community exposure standards and validating low-cost sensors (Stefaniak et al., 2021). Cross-cultural research examining industrial environmental health in diverse global contexts is essential, as most research comes from high-income countries yet challenges may be more severe elsewhere (Fathi et al., 2024). Research examining climate change interactions represents an emerging frontier, as climate change may alter pollutant dispersion, increase accident frequency, and compound vulnerabilities. Economic research examining costs and benefits could strengthen advocacy, quantifying healthcare costs and productivity losses from exposures. Policy research examining implementation and effectiveness would inform regulatory reform, evaluating different regulatory approaches and enforcement mechanisms (Goldman et al., 2022).

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