HHS Public Access

Author manuscript

Occup Environ Med. Author manuscript; available in PMC 2024 February 27.

Published in final edited form as:

Occup Environ Med. ; 81(2): 109–112. doi:10.1136/oemed-2023-108988.

Health Hazard Evaluations of Occupational Cancer Cluster Concerns — United States, January 2001–December 2020

Dallas Shujing Shi, MD PhD[1,2], **Jessica Rinsky, PhD MPH**[1], **George Reed Grimes, MD**[1,*], **Sophia Chiu, MD MPH**[1]

[1]Division of Field Studies and Engineering, National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Cincinnati, OH

[2]Epidemic Intelligence Service, Centers for Disease Control and Prevention, Atlanta, GA

Abstract

Objectives.—To describe recent investigations of potential workplace cancer clusters.

Methods.—We identified Health Hazard Evaluations (HHEs) of cancer concerns during 2001–2020. We described information about industry, requestors, cancer characteristics, investigative procedures, and determinations about the presence of a cluster (i.e., presence of excess cases, unusual case distribution, or exposure).

Results.—Of 5,754 HHEs, 174 included cancer concerns, comprising 1–5% of HHEs per year. In 123 HHEs, the cancer cluster concerns involved different cancer primary sites. Investigation procedures varied but included record review (n=63, 36%) and site visits (n=22, 13%). Of 158 HHEs with a cluster determination by investigator(s), 151 (96%) were not considered cancer clusters. In seven HHEs, investigators found evidence of a cluster, but occupational exposure to a carcinogen was not identified.

Conclusions.—The proportion of HHEs on workplace cancer cluster concerns remained steady over time; most did not meet the definition of a cluster or uncover an occupational cause. Public health practitioners can use this information to provide updated context when addressing workplace cancer cluster concerns and as motivation to refine investigative approaches. More broadly, this review highlights an opportunity to identify best practices on how to apply community cluster investigation methods to the workplace.

Corresponding Author: Dallas S. Shi MD PhD, Division of Field Studies and Engineering, National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Cincinnati, OH, 1090 Tusculum Ave, R-9, Cincinnati, OH 45226, 801-558-6850, Rhq9@cdc.gov.

*George R. Grimes is now affiliated with Division of Injury Compensation Programs, Health Systems Bureau, Health Resources and Services Administration, Rockville, MD

Contributorship: Sophia Chiu, George R. Grimes, and Dallas S. Shi planned and performed data abstraction for the study. Dallas S. Shi performed the data analysis. Jessica Rinsky and Sophia Chiu supervised the study and assisted with data interpretation. All authors contributed to the final version of the manuscript.

Competing interests: None declared.

Ethics approval: This study does not involve human participants.

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention.

Keywords

cancer; occupational health; workplace investigation

Introduction:

Cancer clusters, defined as a greater-than-expected number of the same or etiologically related cancer cases within a group of people in a geographic area over a period of time, can be distressing for those affected.[1–3] Investigations of suspected cancer clusters are important for addressing concerns but rarely identify unusual patterns of cancer or a common cause, prompting need for continuous evaluation of the investigative process and outcomes.[4]

The National Institute for Occupational Safety and Health's (NIOSH) Health Hazard Evaluation (HHE) Program was created to comply with a mandate in the Occupational Safety and Health Act of 1970. The Program responds to valid requests for investigation of workplace health hazards from employers, employees and their representatives, and government agencies[1]. In response to a request, HHE Program staff perform an evaluation and provide recommendations for controlling occupational health hazards and improving worker safety. Requests concern a range of chemical, physical, and biological hazards, and adverse health outcomes. One health outcome the Program is often asked to investigate is suspected cancer clusters in workplaces. Although there is no standardized approach for investigating occupational cancer clusters, NIOSH investigators apply principles used in community cancer cluster investigations and use several lines of epidemiologic evidence to make determinations about the presence of a cluster.

A previous review examined 61 cancer cluster HHEs during 1978–1984.[5] NIOSH has continued to respond to similar HHE requests. The objective of this analysis was to 1) summarize workplace cancer concerns, investigation methods used, and findings from cancer cluster HHEs conducted by NIOSH during 2001–2020 and 2) use this descriptive information to provide context and inform best practices for future investigations. This review focused on recent experience rather than beginning when the previous review ended to provide public health practitioners with current information.

Methods:

We analyzed HHEs on potential workplace cancer clusters requested, investigated, and completed during January 1, 2001–December 31, 2020. We queried NIOSH's HHE database with the keyword cancer and analyzed all completed HHEs identified.

We extracted the following information from the database into Microsoft Access: open date, close date, requestor type, North American Industry Classification System code[2], workplace state, and Occupational Safety and Health Administration region[3]. We abstracted additional

[1]Health Hazard Evaluations. (2019, September 30). https://www.cdc.gov/niosh/hhe/default.html
[2]North American Industry Classification System. United States Census Bureau. https://www.census.gov/naics/
[3]OSHA regions presented as regional/State Plan alliances. OSHA Alliance Program | Occupational Safety and Health Administration

information from final documentation for each HHE: number of workers, number and type of cancer(s), investigation procedures (i.e., cancer registry, medical, and environmental record review; employee interview or questionnaire administration; industrial hygiene sampling; rate calculations such as proportional mortality ratio, standardized incidence ratio, or standardized mortality ratio; site visit), and presence of a suspected exposure.

Because there is no standard method for determining the presence of an occupational cancer cluster, investigators considered individual cancer cluster criteria (i.e., presence of an excess of cancer cases, an unusual distribution of cancer, or carcinogens in the workplace), and latency to make a final cluster determination about whether a cancer cluster existed, all of which we abstracted. An unusual distribution of cancer is defined as the occurrence of cancer in a demographic group that is not typical (e.g., breast cancer in males). Latency is the duration between the start of potential exposure or employment at the work site and cancer diagnosis. Investigators typically considered latency only when one or more of the other individual cancer cluster criteria was met. We calculated the frequency of variables listed above and presented counts and proportions for all categorical variables using R (version 4.0.3; R Foundation for Statistical Computing). If an investigator omitted their determination on individual cancer cluster criteria or their final cluster determination in the abstracted documentation for each HHE, we considered this information missing. In some HHEs, there was information available on an investigators' final cluster determination but not on individual cancer cluster criteria determinations. We calculated the frequency of variables listed above and presented counts and proportions for all categorical variables using R (version 4.0.3; R Foundation for Statistical Computing). This activity was reviewed by the Centers for Disease Control and Prevention (CDC) and conducted in accordance with applicable federal law and CDC policy.[4] CDC did not consider this activity research as defined in 45 CFR 46.102(l) because the data were collected through HHEs, which are a public health practice activity conducted by NIOSH under statutory authority (42 CFR 85). Therefore, IRB review was not required.

Results:

Of 5,754 HHEs identified, 237 were completed and had "cancer" as a keyword; we excluded duplicates (n=9) and HHEs where cancer was not a main concern (n=54), leaving 174 HHEs for analysis. HHEs focused on cancer cluster concerns comprised 1–5% of HHEs per year. The most common industry sector was public administration (32%) (Table 1). Most requests came from employees (40%), management (35%), and union representatives (19%).

HHEs included 1–117 cancer cases, involving <1–50% of the workforce (data not shown). Concerns usually involved multiple cancer sites (n=123/174, 71%). The most frequently reported cancer sites were breast (n=93), lung/bronchus (n=53), and colon/rectum (n=50). Investigators reviewed records for 36% (n=63) of HHEs; records reviewed included cancer registry data (n=10), environmental records (n=53), and medical records (n=19). Investigators conducted interviews or administered questionnaires for 14% (n=25) of HHEs,

[4]See e.g., 45 C.F.R. part 46; 21 C.F.R. part 56; 42 U.S.C. §241(d), 5 U.S.C. §552a, 44 U.S.C. §3501 et seq.

made a site visit for 13% (n=22), calculated cancer rates in 8% (n=14), and conducted environmental sampling in 7% (n=13) of HHEs.

Seventy-four percent (128/174) of HHEs included investigator determinations regarding individual cancer cluster criteria (Table 1). Most (n=110, 63%) found no evidence of an excess or unusual distribution of cases and no presence of a known exposure. Eighteen HHEs (10%) met ≥1 criterion; in 8/18 (44%), investigators found a sufficient latency period (data not shown).

In 158 of 174 HHEs (91%), investigators made a final determination regarding evidence of a cluster (Table 1); 7/158 (4%) were considered a cluster, the remaining 151 (96%) were not. Of the seven HHEs where evidence of a cluster was found, investigators found an unusual distribution of cancer in six (86%) (Supplemental Table 1). Three (43%) involved brain cancers. Three (43%) were from the healthcare and social assistance sector. Requestors reported exposures of concern in two of the seven clusters (29%); exposures of concern were radon and ionizing radiation. However, investigators determined that occupational exposure to a carcinogen was unknown or unclear in all seven HHEs.

Discussion:

The proportion of HHEs conducted to investigate cancer cluster concerns has remained constant during the last two decades. As with community cancer concerns, workplace cancer concerns are distressing to all parties involved and there is often an expectation that an investigation will document an unusual pattern of cancer linked to a workplace exposure.[6] However, similar to Schulte et al., we found that most concerns submitted to the HHE Program involved cancer sites that are prevalent in the U.S. population and lacked evidence of a common workplace carcinogenic exposure.[5, 7]

Nonetheless, government agencies have a responsibility to respond to concerns affecting populations they serve even when the situation is not ideal for conducting a high-quality, epidemiologic study.[5] In these situations, investigators must rely on available data, resources, and guidance to evaluate the concerns. Investigation steps taken as part of the HHEs in this review varied widely. For example, only a third of cancer cluster HHEs involved record review. Variability in the approaches taken reflects the characteristics of the concern (e.g., presence of factors indicating the need for further investigation) and what types of data were available. While HHE Program investigators rely on principles provided in community investigation guidance, no roadmap for applying such guidance to occupational settings exists.

During 2001–2020, several versions of community cancer investigation guidance were in place, which included slightly different definitions of “cancer cluster.”[1, 3] The definition from CDC’s 2013 cancer cluster investigation guidelines[1] encompassed some of the timeframe of HHE investigations reviewed. In 2022, CDC published updated guidance including a revision to the definition of a cancer cluster to recognize that different cancers may be similar etiologically, which can be used moving forward.[8] While investigation principles discussed in community investigation guidance are applicable to the occupational

setting, available data sources and thus methods differ. Cancer registry and denominator data are based on residence whereas a workplace may draw workers from multiple geographic areas, even crossing state boundaries at times. Administrative data available from workplaces may not always include demographic or work history information to define the population at risk. Finally, because of the healthy worker effect and long latency for some cancers, identifying an appropriate comparison population can be challenging. As a result, calculating cancer rates or comparing incidence to a referent population can require additional considerations. One element that may be more straightforward in the occupational setting is identification of carcinogens through review of records and sampling, when appropriate. Recognizing these distinctions and unique challenges illustrates the importance of a tailored approach to occupational cluster investigations that builds on best practices identified in community investigations.

A tailored approach to occupational cancer cluster investigations can benefit the HHE Program and other entities, including other health agencies that perform these investigations or refer concerned parties to the HHE Program or other entities. A common framework established in collaboration with organizations that perform occupational cluster investigations such as state or local health agencies and cancer registries should incorporate best practices from existing guidelines from within the United States and other countries, address how to apply existing guidance to workplace settings, and encourage interdisciplinary collaboration. Based on this review and differences between community and occupational cancer cluster investigations, we propose three areas of focus to aid public health practitioners in developing best practices for occupational cancer cluster investigations and inform what should be considered in a framework. First, similar to community investigation guidance, having a stepwise process for determining the need for further investigation is helpful in providing an efficient response to concerned parties. Second, identifying administrative data sources to define and understand the population of workers who should be included in the evaluation is necessary. Third, stronger collaboration between occupational health practitioners and cancer registries can help facilitate case identification and cluster determination.

Considering our results and previous findings, it is reasonable to ask whether the benefits of these investigations outweigh the costs. However, there are many benefits. Such investigations can provide surveillance for workplace exposures to unknown or suspected carcinogens. Approximately one-third of human carcinogens were first documented in worksite studies.[9] Further, these investigations provide opportunities to engage with workers, to encourage prevention and screening as appropriate.[10] How investigations address heightened emotions surrounding a suspected workplace cancer cluster is hard to quantify.[2] The role of active listening and validation of worker concerns cannot be undervalued and is a critical public health responsibility.[6] Workplace cancer cluster investigations can be opportunities to empower and engage workers, management and unions to speak up about and address workplace health concerns, establish trust, and provide education.[6, 11, 12] These benefits should be considered when developing more tailored guidance for occupational cancer cluster investigations.

The findings presented here are subject to several limitations. Data were abstracted from existing investigation documents; some were incomplete. Methods for investigating cancer clusters were not standardized. The biological plausibility of carcinogenesis related to reported exposures, an investigator's training, and requestors' perception of workplace health hazards affect investigation design, limiting consistency across HHEs. Finally, our findings might not be generalizable as our Program's investigations might not represent all workplace cancer cluster investigations.

Investigations of workplace cancer cluster concerns indicate that these concerns continue to be reported. Although investigations often find no evidence of a cancer cluster or common cause, it remains important to address these concerns using a clear approach understandable to all parties. Public health practitioners can use this information to provide context for future cancer cluster investigations, refine investigative approaches, and more broadly, to develop a national framework to apply cluster investigation methods to the workplace.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgements:

We acknowledge Sheldon Walker, Barbara Jenkins, Kelsey Sumner, and Kaitlin Kelly-Reif for their contributions to this project.

Funding statement:

This study did not receive funding.

References:

1. Investigating suspected cancer clusters and responding to community concerns: guidelines from CDC and the Council of State and Territorial Epidemiologists. MMWR Recomm Rep, 2013. 62(Rr-08): p. 1–24.
2. Renault M Something Is Wrong Here.' More than 100 Local Residents Had Brain Tumors, but What Was the Cause?
4. Goodman M, et al. , Cancer cluster investigations: review of the past and proposals for the future. Int J Environ Res Public Health, 2014. 11(2): p. 1479–99. [PubMed: 24477211]
5. Schulte PA, Ehrenberg RL, and Singal M, Investigation of occupational cancer clusters: theory and practice. Am J Public Health, 1987. 77(1): p. 52–6. [PubMed: 3789238]
6. Simpson BW, Truant P, and Resnick BA, Stop and listen to the people: an enhanced approach to cancer cluster investigations. Am J Public Health, 2014. 104(7): p. 1204–8. [PubMed: 24832152]
7. Mattiuzzi C and Lippi G, Current Cancer Epidemiology. J Epidemiol Glob Health, 2019. 9(4): p. 217–222. [PubMed: 31854162]
8. CDC/ATSDR. Guidelines for Examining Unusual Patterns of Cancer and Environmental Concerns.
9. Blair A, Marrett L, and Beane Freeman L, Occupational cancer in developed countries. Environmental Health, 2011. 10(1): p. S9. [PubMed: 21489219]
10. Aldrich T and Sinks T, Things to know and do about cancer clusters. Cancer Invest, 2002. 20(5–6): p. 810–6. [PubMed: 12206154]
11. Cancer Cluster Guidelines | CDC.
12. Robinson D, Cancer clusters: findings vs feelings. MedGenMed, 2002. 4(4): p. 16.

What is already known on this topic

Suspected workplace cancer clusters are distressing for those affected and can be challenging to investigate. Currently, a consistent framework for applying principles of community cluster investigation guidance to workplace investigations does not exist.

What this study adds

This study provides a review of recent investigations of potential workplace cancer clusters, investigative methods used, and outcomes.

How this study might affect research, practice, or policy

Public health practitioners can use this information to refine investigative approaches and identify best practices on how to apply existing cluster investigation methods to the workplace.

Table 1:

Characteristics and findings of completed NIOSH Health Hazard Evaluations (HHEs) of workplace cancer cluster concerns — United States, 2001–2020.

Characteristic	**2001–2020 No. (%)***
Requested and completed cancer cluster HHEs	174 (100)
Industry sector	
Public Administration	56 (32)
Healthcare and Social Assistance	28 (16)
Educational Services	25 (14)
Manufacturing	16 (9)
Transportation and Warehousing	12 (7)
Information	5 (3)
Other†	24 (14)
Unknown	8 (5)
Requestor type	
Employees	69 (40)
Management	61 (35)
Union	33 (19)
Government§	9 (5)
Joint	2 (1)
Number of cancer sites	
Single	39 (22)
Multiple	123 (71)
Unknown	12 (7)
Cancer Site ¶	
Breast	93 (53)
Lung/bronchus	53 (30)
Colon/rectum	50 (29)
Brain	46 (26)
Prostate	41 (24)
Lymphoma	34 (20)
Thyroid	25 (14)
Uterine	24 (14)
Bladder	22 (13)
Leukemia	22 (13)
Ovarian	21 (12)
Melanoma	19 (11)
Pancreas	18 (10)

Characteristic	2001–2020 No. (%)*
Oropharyngeal	17 (10)
Cervical	16 (9)
Kidney	15 (9)
Stomach	14 (8)
Esophagus	13 (7)
Multiple Myeloma	13 (7)
Skin (Not melanoma)	12 (7)
Skin (Not specified)	10 (6)
Liver/bile duct	9 (5)
Mesothelioma	2 (1)
Other cancer site	43 (25)
Unknown cancer site	35 (20)
Investigative procedures ¶	
Interview/questionnaire	25 (14)
Sampling	13 (7)
Site visit	22 (13)
Rate calculations (e.g., PMR, SIR, SMR) **	14 (8)
Record review	63 (36)
Type of records reviewed¶	
Cancer registry	10 (6)
Environmental records††	53 (30)
Medical records	19 (11)
Unspecified	98 (56)
Individual criteria determination	
Individual criteria determination available¶	128 (74)
Excess number of cases§§	4 (2)
Unusual distribution of cancer	8 (5)
Carcinogenic exposure present	11 (6)
HHEs meeting ≥1 criterion	18 (10)
No excess number of cases AND no unusual distribution AND no exposure present	110 (63)
Individual criteria determinations unknown	46 (26)
Final determination	
Cluster exists, but work-related exposure unknown or unclear	7 (4)
No evidence of a cluster	151 (87)
Final determination unknown§§	16 (9)

*Denominators for percentages in parenthesis are 174

[†] Other industries include construction; finance and insurance; professional, scientific, and technical services; other serves (except public administration); mining; retail trade; real estate rental and leasing; arts, entertainment, and recreation; utilities; wholesale trade; and administrative support, waste management, and remediation services.

[§] Government includes federal, state, and county agencies (e.g., work locations such as health departments, public safety agencies, and courthouses).

[¶] Categories are not exclusive.

[**] Abbreviations represent proportional mortality ratio (PMR), standardized incidence ratio (SIR), and standardized mortality ratio (SMR).

[††] Environmental records include industrial hygiene assessments of the facility, regulatory files, environmental data or information, maps and building schematics, records, drawings, and reports regarding environmental matters.

[§§] Of four HHEs where excess number of cancer cases was found, three were also determined to have an unusual distribution of cancer

[¶¶] Final determination was not available in documents extracted for 16 of 174 HHEs