U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
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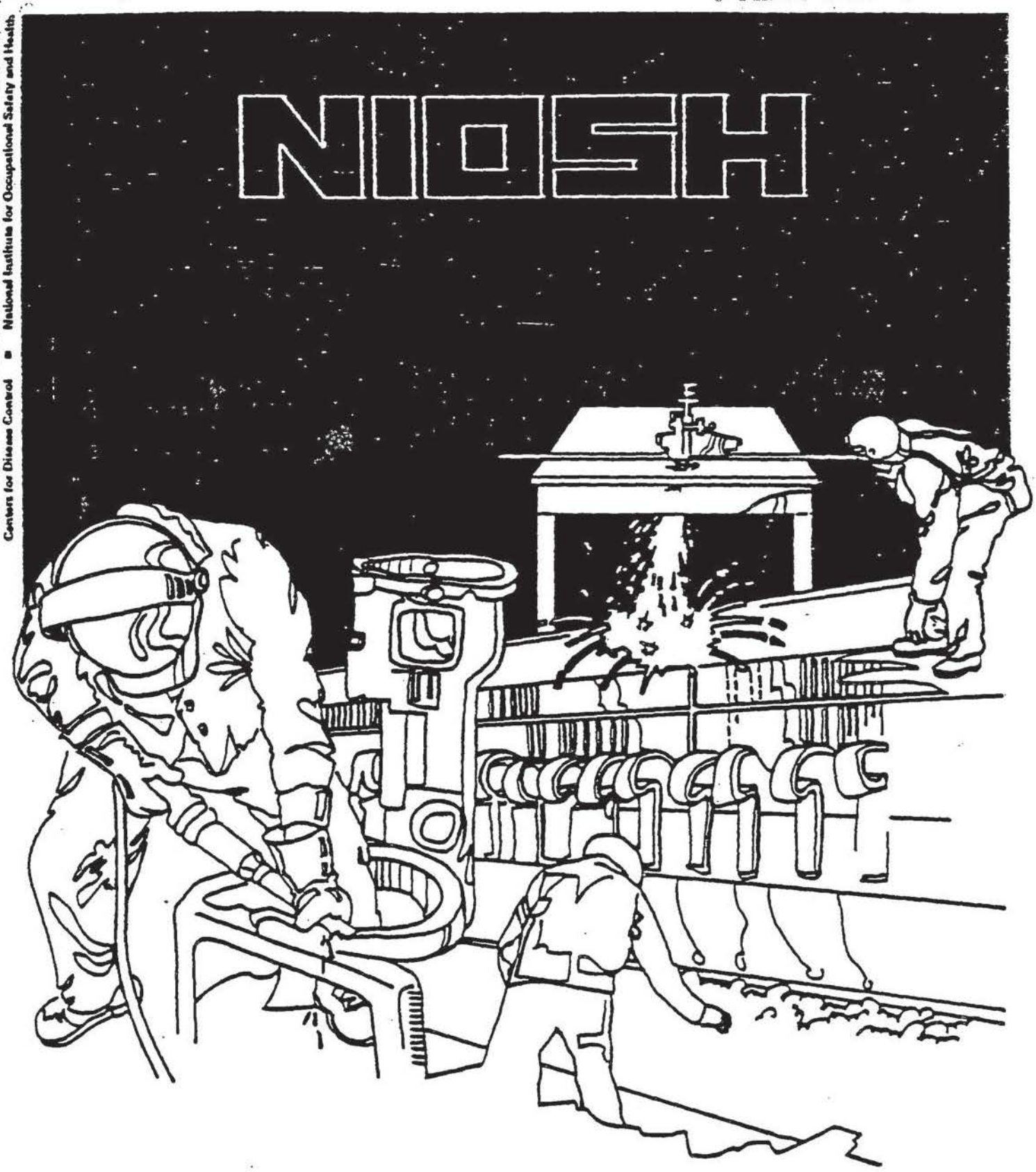

Health Hazard Evaluation Report

HETA 83-360-1495
CHESTER FIRE DEPARTMENT
CHESTER, PENNSYLVANIA

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

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CHESTER FIRE DEPARTMENT
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I. SUMMARY

On July 20, 1983, the National Institute for Occupational Safety and Health (NIOSH) was requested by the International Association of Fire Fighters to evaluate possible long-term health effects in fire fighters in Chester, Pennsylvania, who in 1978 fought a fire at a chemical waste dump. Several of the fire fighters had subsequently developed malignancies. Previous evaluation by the Environmental Protection Agency showed that 32 carcinogens or toxins and five heavy metals were detectable at the dump site.

To evaluate the cancer incidence in the fire fighters, a questionnaire survey of all exposed personnel was performed. Results for 108 respondents were evaluated to determine incident cases. Additional case-finding was performed by interviewing fire fighters, local officials, and union representatives.

Six cases of cancer were observed in the cohort exposed to this fire. The cancers included two lung, one thyroid, one melanoma, one laryngeal, and one Hodgkin's Disease. For the 5.5-year period since the fire, 1.8 malignancies (of all types) would have been expected in this group. The Standardized Incidence Ratio is 341, $p = 0.009$. This result indicates an excess occurrence of cancer, but because of reasons of latency and biological plausibility it may represent the risk attributable generically to fire fighting and not a specific result of fighting the particular fire under investigation. These results are reflective of short latency periods and may not accurately portray any long-term risk of a specific additional cancer incidence in these workers.

There is a statistically significant excess incidence of all cancers combined among fire fighters and other personnel who extinguished the ABM-Wade fire. The precise explanation for this excess is unclear. It is not likely that the excess is related to that fire even though these workers were exposed to numerous carcinogens and their thermal decomposition products. Whether they may in the future be at an additional risk of cancer cannot be determined.

KEYWORDS: Cancer, fire fighters, toxic wastes, chemical dump, cluster
SIC 9224

II. INTRODUCTION

In July, 1983, NIOSH received a request from the International Association of Fire Fighters to determine if there are long-term health effects in fire fighters from Local 1400 in Chester, Pennsylvania, who fought a fire at a chemical waste dump in 1978. The request was prompted by the occurrence of cancer in several fire fighters and concerned, primarily, the possibility of an increased incidence of cancer in this group. A site visit was conducted in August, 1983. Subsequently, all personnel who were present at the fire were included in the investigation.

III. BACKGROUND

In February, 1978, fulltime and volunteer fire fighters from the Chester Fire Department and from other departments in the surrounding area of Delaware County responded to an intense fire at the Eastern Rubber Reclaiming, Inc. plant. The fire fighters believed that the plant was a rubber tire reclaiming operation, but, in actuality, it was also the site of a surreptitious dump for chemical wastes. The 4.5 acre site, known as the ABM-Wade site, had accumulated 18,000-20,000 drums of chemical waste prior to the fire.[1] The fire consumed and collapsed parts of buildings and ignited chemicals stored in drums and in a tank truck. The fire rekindled three days later and fire fighters returned to the scene to extinguish it. Several weeks later, a second fire broke out and had to be extinguished.

The fire was very hot and fire fighters reported drums exploding and shooting in all directions like rockets. During the initial hours, most of the fire fighters wore no respiratory protection as they were unaware that the fire involved chemical wastes. Fire fighters were at the scene for as long as 18 hours. Some fire fighters reported that boots and turnout jackets were literally "eaten off" them by the chemicals with which they came in contact.

Forty-eight fire fighters were treated at local emergency rooms for smoke inhalation, dermatitis, and traumatic injuries; only two--each of whom had a prior history of cardiovascular disease--were admitted for observation.

Because of the potential of this site to pose an imminent hazard, justifying action under Section 7003 of the Resource Conservation and Recovery Act, the National Enforcement Investigations Center of the Environmental Protection Agency investigated the site in March, 1979. Thirty-two organic compounds were identified in 15 ambient air samples and 17 soil/liquid samples. The organics included: benzene, methylethylketone, p-dioxane, ethylene dichloride, trichloroethylene,

hexane, methylene chloride, methyl methacrylate, pentane, 4-methyl-2-pentanone, toluene, 1,1,2-trichloropropane, 1,4-dichlorobenzene, 1,3,5-trimethylbenzene, 1-chloro-3-nitobenzene, bis (2-ethylhexyl) phthlate, dibutylphthlate, 1,2-dichlorobenzene, naphthalene, diphenylamine, phenanthrene. In addition, lead, zinc, copper, nickel, and chromium were also detected. Many of these potentially toxic substances are known or suspected carcinogens.[2]

In October, 1979, the Chronic Disease Division of the Centers for Disease Control (CDC) investigated the public health risk associated with the site. The investigation included: 1) a non-random, door-to-door symptom survey of residents in the immediate vicinity of the dump; 2) interviews with local physicians about any children with illnesses that might have been related to the site; and 3) a voluntary questionnaire survey of fire fighters. No significant health effects were identified by the first two methods. Among 35 fire fighters surveyed, the following symptoms were reported: headache (34%), cough (26%), skin rash (20%), and eye irritation (11%). The CDC report indicated that there were no prevalent health effects, but that long-term, public health sequelae could not be determined at that time.[1]

In 1983, NIOSH was requested to investigate the potential long-term health effects in this cohort after several cases of cancer had been diagnosed in these fire fighters since the fire. An epidemiologist and a medical officer visited the site and interviewed fire fighters and local officials in August, 1983. A study was initiated to ascertain whether there was an excess of cancers among the fire fighters and other personnel who were present at the fires at the ABM-Wade site.

IV. EVALUATION DESIGN AND METHODS

An epidemiologic study was designed to assess whether the incidence of cancer in personnel involved in the ABM-Wade fire was greater than that which normally would be expected in such a group. The number of personnel actually present at the fire was uncertain and differing estimates were obtained. This inconsistency was partially a result of the fact that there were actually three fires at the site: the initial blaze, the rekindle three days later, and a subsequent fire several weeks later. Further difficulty arose from the fact that volunteer personnel who were recorded as having responded to the first fire often served by providing coverage at a Chester fire station--i.e., they, in fact, had no exposure at the site of the fire. We evaluated records of the Chester Fire Department, the County Fire Marshall, and area volunteer departments in order to construct lists of the personnel at the fire. We developed a self-administered questionnaire and distributed it (with a franked return envelope) through the various

departments to all individuals identified as having responded to any of the three fires. Case-finding was performed using information from the questionnaires, and by interviewing fire fighters identified by Local 1400. We requested medical records from all of the reported cancer cases.

To interpret the cancer incidence, we calculated the expected number of cases of cancer among the personnel at risk by applying age-specific incidence rates to the number of persons in each age group. The Chester area has extensive industrial activities such as ship building and oil refining. Since these economic factors and other local conditions could well affect local cancer rates (especially for tumors such as lung cancer), standard rates from a comparable area were sought. We obtained cancer incidence rates for 1980 from the adjacent Camden County, New Jersey, and applied them to the population at risk. Since the cancers identified in the population at risk were of diverse types, the analysis was performed using the rates for "all cancers combined." We multiplied the annual expected numbers of cases by 5.5 to account for the number of years which had elapsed between the fire and the analysis. We then calculated a standardized incidence ratio to assess the relationship between the observed and expected cases. As there were two lung cancers observed in the study population (all other tumors were of different types), we also performed a separate, similar calculation using Camden County rates for malignancies of the trachea, bronchus, lung, and pleura. Statistical significance was assessed using the Poisson distribution. A p value of less than 0.05 is considered statistically significant.

V. EVALUATION CRITERIA

In order to determine whether there is an excess number of cancers in the population at risk, the observed cases are compared with the expected cases by a measure known as the Standardized Incidence Ratio (SIR). If the ratio is greater than 100, and statistically significant, an excess risk of cancer is believed to be present. Even if an excess SIR is found, however, the situation must be interpreted in terms of consistency with other studies, biological plausibility, and other factors before it can be stated that that particular disease may be the result of a given occupational exposure or circumstance.

VI. RESULTS AND DISCUSSION

We identified approximately 300 persons who may have responded to the Wade fire calls and, thus, were potentially at risk. Questionnaires were sent to this cohort. As a result of the questionnaire responses and discussions with various officials, it is estimated that 125-150 personnel were involved at the fire. We received completed

questionnaires from 108 individuals, of whom 106 were male and 2 were female. Of the 108 respondents 101 were white and seven were black. In addition, through interviews we were able to obtain information concerning three other individuals who had contracted cancers.

Of the 111 individuals about whom we acquired information, we were able to establish that 104 were present in some capacity at the scene of the major fire. The seven who were not present were excluded from the statistical analysis because they were not exposed. Only two respondents were female (and neither had a malignancy). They, too, were excluded from the statistical analysis for methodological reasons. Thus, for the purposes of the statistical analysis, the cohort of persons at risk consisted of the group of 102 male fire fighters, police, paramedics, and ancillary personnel who were present at the scene of the major fire and about whom we were able to obtain information. Because of the small number of blacks in the subject group and since all of the identified cases were among whites, the analysis was done using all-race incidence statistics with blacks and whites combined into one population group. In addition, race-specific statistics for Camden County were not immediately available to us.

As of the autumn of 1983 (the period of data collection), seven cases of cancer had been identified in personnel involved in the fire. Five occurred in fire fighters and one each in a police officer and a paramedic. The seven cases included: two lung cancers, one follicular carcinoma of the thyroid, one Hodgkin's disease, one melanoma, one laryngeal cancer, and one skin cancer. We have been unable to obtain medical records to detail further the specific pathology of the individual cases. One individual with skin cancer, however, was initially diagnosed prior to the fire and hence is not included in the analysis. Thus, using a case definition of any malignancy initially diagnosed after the fire, we are left with six cases.

Table 1 shows the age-specific distribution of the 102 male respondents present at the fire. There were six cancers observed and 1.8 expected. The SIR is 341, $p = 0.009$. Table 2 shows the age distribution and the observed and expected cases of lung cancer. There were two lung cancers observed and 0.4 expected. The SIR is 460, $p = 0.071$. Thus, the occurence of six cases of cancers of various types and primary sites (except for the two lung cancers) in a specific population when only 1.8 would be expected is indicative of a statistically significant excess. The finding of two lung cancers, however, does not represent a statistically significant excess of that particular tumor type.

As described above, we defined as study cases all malignancies which have appeared since the date of the fire. We did this despite the fact

that such an approach is not necessarily consistent with current understanding of chemical carcinogenesis. For chemically-induced cancers there is generally a latency period of many years (typically 10 to 30 years, but, in certain instances, perhaps as short as 5 years) following exposure to a carcinogen before any resultant cancer becomes manifest. The cases thus far observed among this cohort of fire fighters have all appeared within five or fewer years of the 1978 fire. Also, several of the malignancies observed in the fire fighters are not known to have chemical etiologies. To our knowledge there are no known or suspected chemical carcinogens for thyroid cancer.[8,9] Similarly, while there are reports of associations of Hodgkin's Disease with chemical exposures, such an etiology is not generally accepted as established.[10,11] The same situation applies to melanoma, although it may be induced by ultraviolet light.[12,13] Finally, it should be mentioned that most experimental and epidemiological studies of chemical carcinogenesis suggest a pattern of repeated or continuous exposures rather than of one-time exposures inducing tumors.

The levels of exposure at the fire also merit comment. Because of the time elapsed since the incident and the uncertainty as to what substances were present in what quantities at the time of the fire (as distinguished from those later catalogued by environmental sampling), we could not reconstruct a reliable differentiation of exposures. Therefore, we treated as equally exposed all individuals present at the scene. This could have distorted our findings as there were undoubtedly varying degrees of exposures, but we cannot say how better exposure information would have affected the results.

In conclusion, several cases, if not all of them, should be considered unrelated to exposures at the fire site because of unrealistic latency periods or for other reasons relating to biological implausibility. Although there has been a statistically significant greater number of cancers in this group than would have been expected in a population of its size and age distribution, we cannot, at this time, plausibly attribute this statistical result to the exposures at the fire.

Fire fighting is clearly a hazardous occupation with a diversity of chemical exposures. There is little reliable literature on the effects of exposure to mixtures of waste chemicals or to their thermal decomposition products, but what is known from studies of exposures to single chemicals suggests that any risks will be no smaller with such mixed exposures.[14] Fire fighters have been shown to be at increased risk of cancer.[3-6] It is certainly possible that the exposures at the ABM-Wade fire have added to the overall cancer risk of the fire fighters who were present, but it is difficult to attribute any particular current cancer to the fire. The finding of an excess of

cancers in this group could represent an excess risk generic to fire fighters and not specific to this fire.

The personnel who were at the fire represent a group of workers who have been identified and essentially notified (by media, previous government reports, their union) that they have been exposed to cancer causing substances. This is likely to have certain residual effects in terms of anxiety and concern beyond any potential physical effects. Workers who have been identified in such a manner sometimes have needs for counseling, medical surveillance, and understanding on the part of employers, even had no excess disease been found. In the current situation, no specific, directed medical surveillance can be indicated as no particular cancer appears to be at excess and since the exposures are non-specific. This may be of little comfort to exposed fire fighters. Consequently, an on-going program of medical advice or counseling about cancer might help to alleviate some of the concerns of the fire fighters. Clearly, for such high risk occupations as fire fighting, periodic medical evaluations should be performed and these could include such counseling.

VII. RECOMMENDATIONS

1. Owing to the general risks associated with fire fighting, periodic medical screening for the involved personnel is recommended. This should include a regular history and physical exam and should take into account the American Cancer Society recommendations for routine screening for cancer in adults (Appendix A).

2. Improve fire department information concerning the presence of potentially toxic substances in the area of coverage so that fire fighters responding to alarms will know in advance if they are likely to encounter such substances and will be able to take appropriate precautions in advance.

3. Ancillary personnel, police, etc. should be provided with appropriate personal protective equipment and trained in its use, or be stationed in areas where such gear is not necessary.

VIII. REFERENCES

1. CDC. Multiple toxic chemicals in an illegal dump, Chester, Pennsylvania. EPI-80-12-2. Centers for Disease Control, 1980.

2. Environmental Protection Agency. Field investigation for imminent hazard assessment - ABM-Wade disposal site, Chester, Pennsylvania. Environmental Protection Agency, 1979. (EPA publication no. 330/2-79-020).

3. Guralnik L. Mortality by occupation and the cause of death among men 20 to 64 years of age: United States 1950. Vital Statistics - Special Reports, Vol 53, 1963.

4. Berg JW, Howell MA. Occupational and bowel cancer. J. Toxicol. & Environ. Health, 1:82, 1975.

5. Ralph RE. A close look at fire fighters' deaths and injuries. Proc. Symp. Occupational Health and Hazards of the Fire Service, p. 14, January 1971.

6. Mastromatteo E. Mortality in city firemen. Arch. Indust. Health, 20:1-7, 1959.

7. Schulte P, Ringen K. Notification of workers at high risk: An emerging public health problem. AJPH, 74:485-491, 1984.

8. Williams ED. The Aetiology of thyroid tumors. Clinics in Endocrinology and Metabolism, 8:193-207, 1979.

9. Schottenfeld D, Gershman ST. The epidemiology of thyroid cancer. CA - A Cancer Journal for Clinicians, 28:66-86, 1978.

10. Gutensohn N, Cole P. Epidemiology of Hodgkin's disease. Seminars in Oncology, 7:92-102, 1980.

11. Olson H, Brandt L. Occupational exposure to organic solvents and Hodgkin's disease in men - a case referent study. Scandinavian J Work Env Health, 6:302-5, 1980.

12. Wright WE, Peters JM, Mack TM. Organic chemicals and malignant melanoma. American J Ind Med, 4:577-581, 1983.

13. Kripke ML. Speculations on the role of ultraviolet radiation in the development of malignant melanoma. JNCI, 63:541-548, 1979.

14. Bingham E, Niemeier RW, Reid JR. Multiple factors in carcinogenesis. Annals of NY Acad of Sciences, 271:14-21, 1976.

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X. DISTRIBUTION AND AVAILABILITY OF REPORT

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1. International Association of Firefighters
2. Local 1400, Chester, Pennsylvania
3 NIOSH Region III
4. OSHA, Region III

For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

Table 1

Age-specific observed and expected cancers among personnel at the ABM-Wade fire

Age	Number of Persons	Expected	Observed
20-24	9	0.012	0
25-29	17	0.025	0
30-34	19	0.036	1
35-39	10	0.055	0
40-44	9	0.070	2
45-49	13	0.112	1
50-54	10	0.268	0
55-59	4	0.161	1
60-64	7	0.476	1
65-69	2	0.216	0
70-74	1	0.122	0
75-79	1	0.206	0
Total	102	1.759	6

$$SIR = \frac{6}{1.759} \times 100 = 341,\ p=0.009.$$

Table 2

Age-specific observed and expected lung cancers among male personnel at the ABM-Wade fire

Age	Number of Persons	Expected	Observed
20-24	9	0.000	0
25-29	17	0.000	0
30-34	19	0.006	0
35-39	10	0.015	0
40-44	9	0.009	1
45-49	13	0.006	0
50-54	10	0.088	0
55-59	4	0.032	0
60-64	7	0.159	1
65-69	2	0.063	0
70-74	1	0.028	0
75-79	1	0.029	0
Total	102	0.435	2

$$SIR = \frac{2}{.435} \times 100 = 460, \; p=0.071.$$

APPENDIX A

American Cancer Society Guidelines for Cancer Screening

For Age 20-40:

The guidelines for this age group call for the following examinations every three years with the qualification that some people at higher risk may need these examinations more frequently.

Physical examinations should include specific examination of the thyroid, testes, prostate, mouth, pelvic and ovaries, breast, skin and lymph nodes. For women, there should be a baseline breast X-ray (mammogram) between ages 35-40. Pap tests should be performed at least every three years after two initial negative tests one year apart.

For Age 40 and Over:

The guidelines for this age group call for the following examinations on a yearly basis with the qualification that some people with higher risk may need certain tests more frequently.

As above with the addition of digital rectal exam yearly, stool guaiac test yearly after age 50, proctoscopic exam every three-five years after age 50 following two initial negative exams one year apart.