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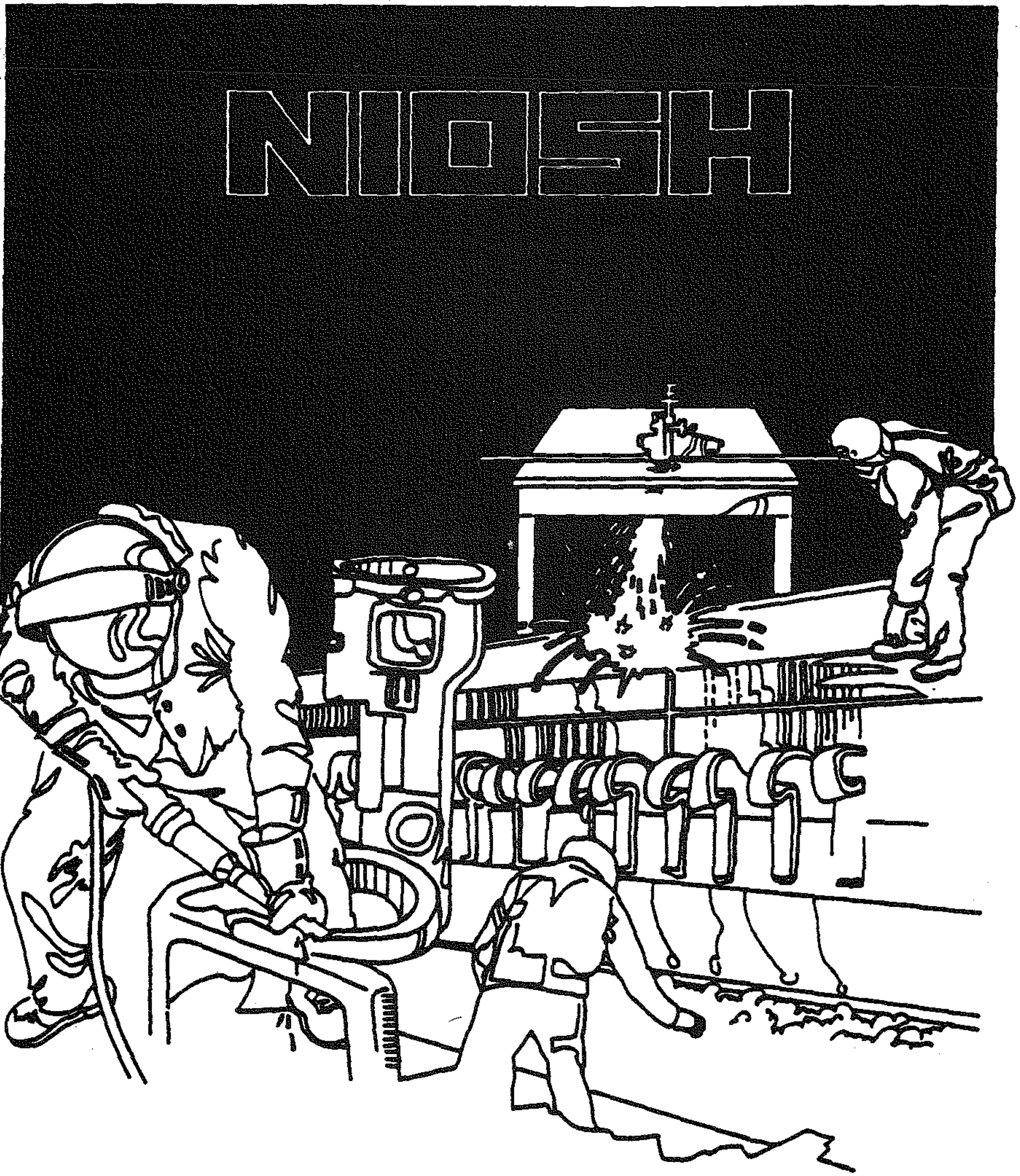

Health Hazard Evaluation Report

HETA 84-416-1673
UNITED HYDRAULICS
HAMPTON, IOWA

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.

HETA 84-416-1673
FEBRUARY 1986
UNITED HYDRAULICS
HAMPTON, IOWA

NIOSH INVESTIGATORS:
Ruth Rondinelli, M.D., M.P.H.
Robert Rinsky
Ralph Bicknell

I. SUMMARY

On June 25, 1984, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Iowa State Health Department to investigate an apparent leukemia cluster at the United Hydraulics (UH) plant in Hampton, Iowa. There had been three leukemia cases (one case each of chronic lymphocytic leukemia, chronic myelocytic leukemia, and acute myelomonocytic leukemia) reported among the 27 workers who had ever worked in the UH honing department since it began production in 1974.

Names of all leukemia and lymphoma cases reported in the nine counties surrounding the UH plant were obtained from the Iowa State Health Registry for the years 1972 through 1984. These were compared with names of all current and past employees contained in UH personnel files. No additional leukemia or lymphoma cases were found. Calculation of person-years at risk among current and past UH employees yielded an estimate of 0.3114 expected leukemia cases based on a population of similar age and size. The three cases of leukemia reported among UH employees exceeded this expected number. Had this observed case excess been found in a study in which a leukemia excess was the prior hypothesis, the difference would be statistically significant, assuming a poisson distribution. ($p < 0.01$, two-tailed)

NIOSH and Iowa State Health Department (ISHD) personnel collected bulk samples of the honing cutting oil and solvent, as well as 15 personal breathing zone and 7 general area air samples for benzene, ethylbenzene and toluene in the honing department and other areas of the plant. The benzene content of the honing cutting oil and solvent ranged from not detectable to 4.2 parts per million. No ethylbenzene or toluene were detected in any area or personal sample. There were two personal samples that showed trace amounts of benzene calculated as an 8-hour time weighted average (TWA); one from a honer (0.06 ppm), and one from a worker from another department (0.07 ppm). The current OSHA standard (currently under review) is 10 ppm averaged over an 8-hour workshift; NIOSH recommends that exposure be as low as feasible.

Pre- and post-shift urine samples for phenol concentration determination were obtained from three honers and from four individuals from other areas of the plant. Four individuals, including all three honing department workers showed cross-shift increases ranging from 1.0-2.6 mg/g creatinine (Cr). These increases appear small when

compared with the range of inter-individual phenol variability and probably do not represent increases that could conclusively be attributed to benzene exposure.

Based upon the results of our environmental and epidemiological evaluation of the United Hydraulics plant, we conclude that (a) there appears to be a clustering of leukemia cases (more cases than one would expect) among workers in the UH plant, but the cases were epidemiologically dissimilar cell types; and (b) current working conditions do not expose UH workers to substantial amounts of benzene, and (c) there has been no evidence of any substantial change in solvents, cutting oils and/or work practice since the company started production in 1973. A prudent work practice would be to provide workers using materials containing solvents with gloves impermeable to benzene and other solvents. The investigation should be reopened in the unlikely event that additional leukemia, lymphoma or aplastic anemia cases should occur.

KEYWORDS: SIC Code 3728 Manufacturer of hydraulic cylinders, leukemia, benzene

II. INTRODUCTION

On June 25, 1984, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Iowa State Health Department (ISHD) to investigate an apparent leukemia cluster at the United Hydraulics (UH) plant in Hampton, Iowa. There had been three leukemia cases reported among the 27 workers who had ever worked in the UH honing department since it began production in 1974. Each demonstrated a different cell type: chronic lymphocytic, chronic myelocytic and acute myelomonocytic leukemia.

On August 14, 1984, NIOSH and ISHD personnel conducted a walk-through inspection of the plant, interviewed honing department employees, and assessed the availability and content of personnel files. On September 17, 1984, bulk samples of new and used honing cutting oil, honing stone solvent, and No. 2 fuel oil were obtained. On December 5-6, 1984 NIOSH and ISHD personnel searched UH personnel files for individuals who had been reported to the Iowa State Health Registry as having leukemia or lymphoma from the nine surrounding counties. On February 13, 1985, 22 air samples were taken in the honing department, on both shifts. Fifteen were personal and seven were area samples. Seven workers were selected to give pre- and post-shift urine samples for determination of phenol concentration. An interim medical letter was written to the Iowa State Health Department with these preliminary data on June 12, 1985.

III. BACKGROUND

A. Process Description

The United Hydraulic plant began operation in 1973. The honing operation started a year later in 1974. The company makes special hydraulic cylinders at a rate of approximately 900 units a month. The interior diameter of the cylinder ranges from 1.5 to 2.0 inches and can be as long as 36 feet. The tube is purchased with 0.050 inches of stock left inside. The honing head goes into the cylinder and removes the inside stock down to the accepted tolerances. Each honing head has eight hone stones (a grit bonded material). Two of the honing stones are removed and replaced with an oak, which acts as a noise dampening device. The honing oil is added as needed. The machines are cleaned once a year. Solvent is used at the rate of 1-2 gallons per week. The stones are changed 3-4 times an hour. The honers put their hands into the solvent and cutting oils to make the changes. When they work with short cylinders, they smell solvents frequently.

B. Exposure Controls, Engineering and Personal Protective Equipment

The ventilation system for most of the plant is a dilution ventilation system. There is local exhaust ventilation in the plating and paint spray areas. Neither of these two systems was operating on the day the environmental survey was made. This was due to a light workload and an outdoor temperature of 0^{o}-$10^{o}F$ during the day.

Personal protective equipment use was variable. Safety shoes and safety glasses were in general use throughout the plant. Gloves were used only in the plating area. Aprons were used by the platers and honers. No respirators were observed being used in the plant.

At the time the survey was made, there were four men employed in the honing department. One of the men was not at work on the day we visited the plant.

IV. METHODS

A. Environmental

Bulk samples of the new and used honing cutting oil and honing stone solvent, as well as a sample of No. 2 fuel oil were obtained on September 17, 1984. These were analyzed by the University Hygienic Laboratory at the University of Iowa, Iowa City, Iowa, for benzene, toluene, ethylbenzene and various other solvents by the NIOSH Method 1501 for aromatic hydrocarbons,[1] and for polynucleated hydrocarbons by using GC/MS analysis.

The February 13, 1985 breathing zone and area air samples were collected using SKC Model-222-3 personal air sampling pumps with activated charcoal tubes, at a sampling rate of 100 cubic centimeters per minute. The samples were analyzed for benzene, toluene, and ethylbenzene. The A & B sections of the charcoal tube samples were separated and analyzed by gas chromatography according to NIOSH Method 1501[2].

B. Medical

The honing cutting oil and solvent, and the No. 2 fuel oil were analyzed for chemical content, including benzene. Even though these oils and solvents contained very low levels of benzene, there was concern that dermal exposure might allow significant absorption of benzene. Therefore, pre- and post-shift urine samples for phenol concentration determination were collected from two honers and two randomly selected individuals, (not working in the honing department) on the first shift, and one honer and two other workers on the second. The samples were placed on ice and shipped to Cincinnati for analysis. The samples were analyzed using the gas chromatographic method in urine (NIOSH Method 8305),[3] for determination of free phenol in urine. These individuals also carried personal air monitors for benzene, ethylbenzene and toluene during the workshift on which they gave pre- and post-shift urine specimens.

Benzene is oxidized in the body to phenols, which in turn are conjugated in the liver with sulfate ions and excreted in urine. Measurement of urinary phenol concentration is an indirect method of assessing benzene exposure, based upon the assumption that between 20 and 40% of the benzene in blood is metabolized to phenol. However, other factors may influence the excretion of phenol in urine; these include: diet, hepatic (liver) disturbances, intestinal putrefactive processes (digestive), and medications such as aspirin and salicylates.[8] Therefore, cross-shift changes in phenol concentrations were examined along with concurrent personal air sampling results for benzene to determine whether honers were exposed to, and/or absorbing more benzene than individuals working at other jobs.

Evaluation of this apparent leukemia cluster required: 1) complete case finding, 2) estimation of the person years at risk, and 3) determination of a causative agent. In order to find additional cases, the ISHD requested the following information from the Iowa State Cancer Registry:

1. A listing of leukemia and lymphoma (Hodgkins and non-Hodgkins) cases reported among residents of a nine-county area surrounding and including Franklin County, between 1970 and 1984; and

2. A listing of all cancers occurring among the 27 individuals known to have worked in the UH honing department since it began operation in 1974.

   NIOSH and ISHD personnel then returned to UH December 5-6, 1984 to compare names obtained from the cancer registry with current and past UH workers listed in company personnel files. These files contained all workers who had ever worked at the company.
   UH personnel files were randomly sampled to obtain a representative sample of the population at risk. (Approximately 20 percent of current and past employee

personnel files were sampled.) These records were used to generate person years at risk of dying from leukemia. The estimate of person years at risk was used, in turn, to generate the number of expected leukemic deaths among the entire plant population.

V. EVALUATION CRITERIA

A. Environmental Evaluation Criteria

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week, for a working lifetime, without experiencing adverse health effects. It is, however, important to note that not all exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy).

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects, even if the occupational exposures are controlled at the level set by the evaluation criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus, potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: 1) NIOSH criteria documents and recommendations, 2) the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV's), and 3) the U.S. Department of Labor (OSHA) occupational health standards. Often, the NIOSH recommendations and ACGIH TLV's are lower than the corresponding OSHA standards. Both NIOSH recommendations and ACGIH TLV's usually are based on more recent information than are the OSHA standards. The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended standards, by contrast, are based primarily on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in the report, it should be noted that industry is legally required to meet those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended short-term exposure limits or ceiling values which are intended to supplement the TWA, where there are recognized toxic effects from high short-term exposures. (See Table I.)

B. Medical Evaluation Criteria

Benzene, toluene and ethylbenzene all affect the central nervous system, resulting in such symptoms as headache, vertigo (dizziness) light-headedness, drowsiness, confusion, and incoordination. Vapors from these chemicals are irritating to the eyes, nose and throat, and skin contact can result in dermatitis, secondary to the defatting properties of these solvents. Aspiration of benzene into the lungs results in pulmonary edema and hemorrhage. Chronic exposure to benzene can cause decreased production of red blood cells, white blood cells, and platelets, resulting in aplastic anemia, impaired ability to fight infections and bleeding problems. Benzene can also cause leukemia. Although toluene and ethylbenzene are not currently associated with the development of leukemia, industries frequently use a commercial grade of these compounds which may contain some benzene.[4,5]

In order to reduce the risk of leukemia, NIOSH recommended in 1977 that exposure to benzene not exceed 1 ppm.[6] This criterion, initially a 2-hour TWA, then later a 1-hour TWA as analytical sensitivity improved, was chosen because it represented the limit of analytical reliability.[7] As with other carcinogens, NIOSH recommends that employee exposure to benzene be reduced to the lowest feasible level (LFL). The evaluation criteria (8-hour TWA) for benzene, toluene, and ethyl benzene are listed as follows in Table I:

Table I.

	ACGIH		OSHA		NIOSH	
	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3
benzene	10*	30	10	30	LFL	3
toluene	100	375	200	750	100	375
ethyl benzene	435	100	100	435	--	--

*Suspected of carcinogenic potential for man - ACGIH TLV List.

VI. EVALUATION OF RESULTS AND DISCUSSION

A. Environmental Survey

Liquid bulk samples from new and used honing stone solvent, new and used cutting oil, and Fuel Oil No. 2 were analyzed for benzene, ethylbenzene, toluene and other solvents, as well as polynuclear aromatic hydrocarbons (PAH's). These results are listed in Table II.

Table II

liquid bulk sample	benzene (ppm)	ethylbenzene (ppm)	toluene (ppm)
new honing solvent	ND*	24.40	0.44
used honing solvent	0.40	19.00	8.40
new cutting oil	0.95	20.00	5.00
used cutting oil	4.20	180.00	100.00
Fuel Oil No. 2	33.00	640.00	400.00

*limit of detection: benzene=0.25 ppm
ethylbenzene=0.25 ppm
toluene=0.25 ppm

Napthalene was detected at a concentration of 930 ppm in the used cutting oil, but neither napthalene nor other PAH's were detected in the other tested fluids.

There were 15 personal and 7 area air samples obtained from honers and other UH plant employees. Ethylbenzene and toluene were not detected. The 8-hour TWA personal samples from one honer and one employee from another department detected 0.06 mg/m^3 (ppm) and 0.07 mg/m^3 (ppm) benzene, respectively, (the limit of benzene detection was 0.002 mg/sample). The measured 8-hour TWA for benzene in these workers is well below the OSHA standard and ACGIH TLV. As mentioned above, however, since benzene causes progressive, malignant disease of the blood-forming organs, NIOSH recommends that benzene be considered carcinogenic in man. Because it is not possible at present to establish a safe exposure level for a carcinogen, the NIOSH recommendation is to restrict exposure to very low levels that can still be reliably measured in the workplace (lowest feasible level, LFL).

B. Biological Monitoring

Table III lists the pre- and post-shift urinary phenol concentrations (corrected for urinary creatinine (Cr) concentration) for three employees using the honing machines and four employees from other job descriptions (driller, grinder, machinist) within the plant.

Table III

Pre- and post-shift urinary phenol concentrations corrected for urinary creatinine concentration

employee	pre-shift (creatinine corrected) urinary phenol (mg/g Cr)	post-shift (creatinine corrected) urinary phenol (mg/g Cr)
honer	18.0	19.0
honer	1.7	3.3
honer	5.3	6.7
other department	3.8	6.1
other department	12.0	5.3
other department	14.0	8.6
other department	14.0	7.7

Four individuals, including all three honing department workers showed cross-shift increases ranging from 1.0-2.6 mg/g Cr. These increases appear small when compared to the range of inter-individual phenol variability and probably do not represent increases that could conclusively be attributed to benzene exposure.

Lauwerys (1983)[9] contends that a phenol concentration exceeding 20 mg/liter (this number is corrected for urine specific gravity, not creatinine, but is often roughly comparable) at the end of the working day suggests that workers have been exposed to approximately 1 ppm of benzene, if other causes of elevated urinary phenol have been excluded. One of the honers does have an end of shift phenol of 19.0 mg/g Cr, but the pre-shift phenol was 18.0 mg/g Cr. There is no information available for this individual concerning drug use, diet, or preexisting gastro-intestinal conditions.

The data gathered from breathing zone personal samples and urinary phenol determinations do not appear to provide evidence for substantial benzene exposures. However, the urine phenol measurements lack the sensitivity necessary to detect very low levels of benzene exposure. The current scientific literature does not provide conclusive evidence for a threshold benzene exposure under which there is no risk for development of leukemia.

C. Epidemiological Data Analysis

The Iowa State Tumor Registry identified no additional cases of leukemia or lymphoma among past or current UH employees.

Calculation of the person-years at risk among current and past UH employees yielded an estimate of 0.3114 expected leukemia cases in a population of similar age and size. The three cases of leukemia reported among UH employees exceeds this expected number. Had this observed case excess been found in a study in which a leukemia excess was the prior hypothesis, the difference would be statistically significant, assuming a poisson distribution. ($p < 0.01$, two-tailed)

Leukemia has been associated with benzene, ionizing radiation[10] and the prescription drugs chloramphenicol and phenylbutazone. There have also been several recent epidemiologic studies which have found that farmers have significantly higher mortality rates from leukemia,[11,12], lymphatic tumors[12,14] and multiple myeloma.[11,13].

There are numerous reports of leukemia occurring in individuals exposed to benzene. Myelo-monocytic leukemias are most often associated with benzene exposure. Less frequently, are reports of lymphocytic leukemias. These are generally associated with mixed solvent exposures in which benzene contamination has been implicated as the causative agent.[14,15]

Information regarding case exposure to chloramphenicol, phenylbutazone and ionizing radiation was not available for the three reported cases, however, past work histories were obtained for two of the cases. Both had been farmers. One had had a dairy and later produced grain crops before coming to work for UH. The second had worked 12 years as a mechanic (frequently using solvents to clean parts) and had worked 10 years as a farm laborer (live stock and row crop).

Information concerning the average annual age-adjusted (1970 U.S.) incidence rates per 100,000 by primary site/type, in Franklin County vs. Iowa, 1973-82 (see Table IV), was obtained from the State Health Registry of Iowa. Franklin County had a significantly higher rate of chronic leukemias among men between 1973-82 than did the State of Iowa. (These figures do not reflect the third case of leukemia reported at UH because it was diagnosed after 1982.)

Interestingly, the County has a significantly higher cancer rate for all sites than the rest of the State of Iowa.

Table IV

AVERAGE ANNUAL AGE-ADJUSTED (1970 U.S.) INCIDENCE RATES PER 100,000
BY PRIMARY SITE/TYPE, FRANKLIN COUNTY VS. IOWA, 1973-82

	FRANKLIN COUNTY			IOWA		
	MALE	FEMALE	COMBINED	MALE	FEMALE	COMBINED
All Sites	391.3*	388.9*	390.1*	336.3	307.4	321.5
Bladder	28.1	9.1	18.3*	23.5	6.8	14.9
Breast	N.A.	113.3*	N.A.	0.6	87.2	--
Colon	41.9*	57.6*	50.0*	34.2	40.1	37.2
Rectum	23.0*	22.6*	22.8*	17.2	12.7	14.9
Lung/Bronchus	61.6	12.0+	36.1+	70.1	18.4	43.5
Prostate	88.1*	--	--	61.0	--	--
Stomach	7.2	5.6	6.4	8.6	4.7	6.6
Hodgkins's Disease	1.7+	0.0+	0.9+	3.4	2.5	2.9
Non-Hodgkins's Lymphomas	14.0	11.9	12.9	11.4	10.1	10.7
Leukemias	17.2	11.9	14.5	13.9	9.4	11.6
Acute Leukemias	6.7	5.3	6.0	5.2	3.8	4.5
Chronic Leukemias	10.5*	4.3	7.3	6.9	4.7	5.8

+ County rate is significantly lower than state rate, $p < .05$
* County rate is significantly higher than state rate, $p < .05$

There appears to be a significantly greater number of leukemia cases among past and current UH employees than would be expected for a population of similar age and size. Of further concern is that the cases occurred among workers only from the honing department of the plant. The measured benzene exposures were low, and there is no evidence that solvents, cutting oils and/or work practice has significantly changed since the company started production in 1973. Although occupationally-induced malignancies normally required long latencies, in the case of benzene, leukemias have been reported two years after initial exposure.(16) There were no observed sources of ionizing radiation in the plant. At least two of the three cases are known to have independent risk factors for the development of leukemia, though it is reasonable to suspect that many other workers at UH have also been employed as farmers and/or worked with solvents in other jobs. Finally, Franklin County, Iowa appears to have a somewhat higher incidence rate of cancer from all sites than the State of Iowa, as well as, chronic leukemias in men. If these higher incidence rates are due to some environmental source it may be a confounding factor in the association of leukemia and employment at United Hydraulics.

In conclusion, a cluster of three leukemia cases of differing cell types have occurred among workers at the United Hydraulics plant in Hampton, Iowa. Environmental and biological monitoring of workers have found no demonstrable common cause within the plant. Epidemiologic study has failed to find additional cases. While there appears to be more cases of leukemia than one might expect among workers at this plant, no causative agent has been found in this environment.

VII. RECOMMENDATIONS

1. Despite the fact that no etiologic factor/s at UH could be found to explain the apparent leukemia cluster, it would follow good work practice to reduce solvent exposure among all UH workers. This can be accomplished by consulting with a safety supply house and/or protective clothing manufacturer to identify an apron and gloves, to confer additional protection from aromatic solvents, including benzene.

2. The investigation should be reopened in the unlikely event that additional leukemia, lymphoma or aplastic anemia cases should occur.

VIII. REFERENCES

1. NIOSH Method 1501. NIOSH Manual of Analytical Methods, 3rd Edition, USDHHS, PHS, CDC, NIOSH, 1985.

2. NIOSH Method 1501. NIOSH Manual of Analytical Methods, 3rd Edition, USDHHS, PHS, CDC, NIOSH, 1985.

3. NIOSH Method 8305). NIOSH Manual of Analytical Methods, 3rd Edition, USDHHS, PHS, CDC, NIOSH, 1985.

4. Proctor NH, Hughes JP. Chemical Hazards of the Workplace. Philadelphia: J.B. Lippincott, 1978.

5. Eds. Clayton GD and Clayton FE, Patty's Industrial Hygiene and Toxicology, 3rd Revised Edition, Vol 2C, John Wiley & Sons, New York, 1982.

6. National Institute for Occupational Safety and Health. Revised recommendation for an occupational exposure standard for benzene. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1977.

7. Testimony of Edward J. Baier, Deputy Director, National Institute for Occupational Safety and Health, before the Department of Labor, Occupational Safety and Health Administration Public Hearing on Occupational Standard for Benzene, July 25-26, 1977.

8. Braier L, Levy A, Klaus D and Pardo A. "Benzene in Blood and Phenol in Urine in Monitoring Benzene Exposure in Industry". American Journal of Industrial Medicine 2: 119-123, 1981.

9. Lauwerys, RR, Industrial Chemical Exposure: Guidelines for Biological Monitoring. Biomedical Publications, Davis, California, 1983, pp. 54-47.

10. Eds. Doull J, Klaassen CD and Amdur MO, Casarett and Doull's Toxicology: The Basic Science of Poisons, 2nd Edition, Macmillan Publishing Co., Inc., New York: 1980.

11. Burmeister LF, "Cancer Mortality in Iowa Farmers, 1971-78", JNCI 66: 461-464, 1981.

12. Blair A and Thomas TL, "Leukemia Among Nebraska Farmers: A Death Certificate Study", Am J. of Epi 110: 264-273, 1979.

13. Burmeister LF, et. al., "Selected Cancer Mortality and Farm Practices in Iowa" Am J of Epi 118: 72-77.

14. Eds. Laskin S and Goldstein BD, "Benzene Toxicity: A Critical Evaluation", J Tox Environ Health 2 (suppl 2): 69-105, 1976-77.

15. McMichael AS, Spirtas R, Kupper LL, Gamble JF: Solvent Exposure and Leukemia Among Rubber Workers -- An Epidemiologic Study, Journal of Occupational Medicine 17: 234-39, 1975.

16. Submitted for publication. Rinsky RA, Smith AB, Hornung R, Filloon TG, Young RJ, Oken AH and Landrigan PJ, "Benzene and Leukemia: An Epidemiologic Risk Assessment", 1985.

IX. AUTHORSHIP AND ACKNOWLEDGEMENTS

Report Prepared by:	Ruth Rondinelli, M.D., M.P.H. Medical Officer Medical Section
	Robert Rinsky Epidemiologist
	Ralph Bicknell, C.I.H. NIOSH, Region VII
Originating Office:	Hazard Evaluations and Technical Assistance Branch Division of Surveillance, Hazard Evaluations, and Field Studies
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	JoAnn Muldoon, Epidemiologist, Environmental Health Section, Iowa State Health Department
	William Wyer, Environmental Health Section, Iowa State Health Department
Report Typed By:	Ottavia Frey

X. DISTRIBUTION AND AVAILABILITY OF REPORT

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1. United Hydraulics
2. Iowa State Health Department
3. NIOSH, Region VII
4. OSHA, Region VII

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