



DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Centers for Disease Control
National Institute for
Occupational Safety & Health
Robert A. Taft Laboratories
4676 Columbia Parkway
Cincinnati OH 46226-I 996

January 17, 1997

Ms. Kate Sweeney, Associate General Counsel
National Mining Association
1130 17th Street, NW
Washington, DC 20036

Dear Ms. Sweeney:

The National Institute for Occupational Safety and Health (NIOSH) is collaborating with the United States Army Environmental Hygiene Agency (USAEHA) to develop and conduct a study of uranium millers. This effort was initiated in October, 1994 after Congress appropriated \$500,000 to the Department of Defense in Public Law 103-139 for a "study of the health effects of uranium milling, including the effects of exposure to radon chemicals and uranium, on the health of those individuals employed in uranium mills in the southwestern United States during the period beginning on January 1, 1947 and ending on December 31, 1971."

Before initiating this study, we evaluated the feasibility of various study alternatives. We began by identifying all the uranium mills which operated in the United States. Then, we attempted to locate and evaluate personnel, medical, and exposure records from uranium mills to determine if records existed that would be valuable in designing and conducting a study of uranium millers. We concentrated our efforts on mills which operated in Colorado, Utah, New Mexico, and Arizona between 1947 and 1971. We have almost completed our evaluation of available records from these mills.

Enclosed is a summary of our conclusions about the feasibility of conducting various types of studies entitled "Study Alternatives for Evaluating the Health Effects of Uranium Milling" based on our evaluation to date. Although we plan to evaluate the records from two more uranium mills, we doubt that this review will change our conclusions drastically or our recommendations on how to allocate the remaining funds for studies of uranium millers.

If you have comments on our conclusions and recommendations, please send them to us so that we receive them by February 7, 1997. We understand that this deadline is short. We will accept comments by fax (513 841-4486) or e-mail (LEP@nioshe1.em.cdc.gov), or regular mail.

If you have any questions, you may call us at (513) 841-4344 (Lynne Pinkerton) or (513) 841-4576 (Tom Bloom).

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Sincerely yours,

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Enclosure

STUDY ALTERNATIVES
FOR EVALUATING HEALTH EFFECTS OF URANIUM MILLING

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January 17, 1997

BACKGROUND

NIOSH has an interagency agreement with the United States Army Environmental Hygiene Agency (USAEHA) to develop a definite epidemiologic study of the long term health effects associated with employment in the uranium milling industry. MOSH was contacted by the USAEHA about conducting this study after Congress appropriated \$500,000 to the Department of Defense in Public Law 103-139 for a "study of the health effects of uranium milling, including the effects of exposure to radon chemicals and uranium, on the health of those individuals employed in uranium mills in the southwestern United States during the period beginning on January 1, 1947 and ending on December 31, 1971." We determined the feasibility of conducting various types of epidemiologic studies based on the availability of the personnel, medical, and exposure records from U.S. uranium mills. The purpose of this document is to outline our conclusions about the feasibility of various studies and to solicit comments from external partners.

BRIEF REVIEW OF THE LITERATURE

Renal disease: The kidney is considered the critical organ limiting occupational exposure to soluble uranium compounds in the uranium milling industry.¹ However, there has been relatively little epidemiologic research on the renal effects of chronic, occupational exposure to uranium.

Waxweiler and colleagues observed a slight excess of deaths from renal disease among a cohort of U.S. uranium millers (6 observed, 3.6 expected).² The authors did not view this excess as clearly occupationally related, because all of the cases were short term workers and four died within 8 years of their initial employment in a uranium mill. In addition, the authors felt that 3 deaths were probably secondary renal disease and not associated with uranium exposure. This study is not sufficient to establish that prolonged occupational exposure to uranium causes renal disease but the findings underscore concern about the chronic renal effects of uranium exposure. Because renal disease is not always coded on the death certificate, even if present, clarification of this issue requires more sensitive techniques than mortality studies.

Thun and colleagues assessed the kidney function of 39 uranium mill workers compared to 36 age, race, and sex matched local controls from a nearby cement production facility.³ Urinary excretion of amino acids and β_2 -microglobulin was increased in uranium mill workers compared to controls. These findings were suggestive of renal tubular injury and consistent with the known toxic effect of soluble uranium on the kidney tubules. The level of β_2 -microglobulinuria was significantly associated with years of work in the area of the mill with the highest exposures to soluble uranium.

Non-malignant respiratory disease: Both uranium miners and millers have been observed to have an increased risk of death from non-malignant respiratory disease. Waxweiler et al. in a cohort mortality study of uranium miners, observed 83 deaths from "other non-malignant respiratory diseases" with only 16.6 such deaths expected, indicating that uranium miners had approximately a five-fold risk of death from this cause compared to the U.S. population.⁴ Excess deaths from "other non-malignant respiratory disease" were also reported in a mortality study of

2002 U.S. uranium mill workers by Waxweiler and colleagues.* In this study, mill workers were approximately 2.5 times more likely to die of these causes than would be expected by U.S. death rates, based on 39 observed and 15.6 expected deaths. Neither of these studies reported on the exact diagnoses contributing to this excess, but deaths from silicosis would be coded in this category. In a survey conducted by the U.S. Public Health Service in 1950, 26.5 percent of the white millers and 13.8 percent of the white miners showed more than usual pulmonary fibrosis, as compared to 7.5 percent in a control group.' In the same survey, 20 percent of the Native American millers and 13.2 percent of Native American miners showed more than usual pulmonary fibrosis compared to none of the controls. Ten cases of definite silicosis were found among workers examined the following year but all had a previous occupational history of hard rock mining. The investigators felt that past exposures to hard rock mining, as well as possible current exposures, were the cause of this fibrosis.

It is possible that uranium ore dust and radon daughter exposures contribute to the excess mortality from non-malignant respiratory disease among uranium miners and millers. Radon daughters and uranium ore dust have all been shown independently to induce pulmonary lesions in animals.^{6,7,8} A morbidity study of workers in a uranium processing plant, in which silica exposure was minimal or absent, found increased non-malignant respiratory disease among workers with higher cumulative uranium exposure compared to lower.' No statistically significant association was demonstrative for the non-radioactive chemical exposures.

Cancer: Epidemiologic studies have shown an excess of lung cancer in uranium miners.^{4,10} The occurrence of lung cancer relates closely to the levels of exposure to radon daughters. Unlike uranium mines, mills have not been found to trap high concentrations of radon and radon daughters. Similarly, the two published U.S. mortality studies of mill workers did not show an excess of lung cancer.^{2,11}

Other potential sources of radiation are the long-lived isotopes contained within poorly soluble uranium dusts. Some data from toxicologic studies suggest that these less soluble uranium compounds may accumulate in the tracheobronchial lymph nodes. Archer observed a nearly four-fold excess of deaths from lymphatic and hematopoietic malignancies other than leukemia in a small cohort of uranium millers (4 deaths observed versus 1.02 expected).'' However, a subsequent mortality study of a larger number of uranium millers found only a slight excess of lymphatic and hematopoietic malignancies (excluding leukemia).*

STUDY OPTIONS

be linked with work history records. We found that there were minor discrepancies between the mill selection criteria for the Waxweiler study and the records we found, mainly that there was an additional facility owned by one of the companies whose workers were included but do not seem to be counted in the total of 7 mills. This is not a serious problem. However, there were enough discrepancies between the work histories coded originally and the actual personnel records that we would need to recode the work histories to get accurate employment dates. We found that exposure information, including airborne uranium dust, vanadium dust, silica dust, and radon decay product levels was available for 6 of the mills. However, there was insufficient work history information to make an exposure assessment feasible. Many of the job titles were very general (like laborer) so that it would be impossible to match them with an air sampling location, and for some records it was impossible to determine which mill the person worked in (records from several mills were microfilmed together and the mill name or location was not recorded).

We concluded that an update of the Waxweiler study would be feasible and useful, but that adding an exposure assessment component would not be possible. The incidence of end-stage renal disease could be evaluated in the same study group. We also plan to investigate the application process for obtaining data from state *cancer* registries for a study of cancer incidence among this study group since the mills in the Waxweiler study were located in states that have cancer registries. The update will be done by **NIOSH** and will require a modest investment of funds to validate the work history coding and to update the work histories of people who continued employment after the microfilming was done. We will develop a protocol which outlines the specific steps we plan to *take* to update the study.

2. Expanding the Waxweiler study

Expanding the Waxweiler study to include workers from other mills would increase our ability to detect an increased risk of death from lung cancer, non-malignant respiratory disease, or lymphoma among uranium millers, if such a risk exists. We attempted to locate personnel records⁷ for uranium mills not included in the Waxweiler study so we could add workers from other mills to the study. We concentrated our efforts on 18 mills that operated in Colorado, New Mexico, Utah, or Arizona between 1947 and 1971. We were particularly interested in locating personnel records for mills that operated on the Navajo reservation since the Waxweiler study includes only mills that predominantly employed white millers and if an expanded study was done, we wanted it to be more representative of the different ethnic groups employed in the industry.

Unfortunately, we were unable to locate personnel records from mills located on the Navajo reservation that could be used to expand the Waxweiler study. Although we were able to locate personnel records from other mills, the personnel records, in general, were stored with many other personnel records. In addition, many workers were ineligible for the study because they had uranium mining experience. In some cases, differentiating millers and miners was difficult, if not impossible.

We concluded that expanding the Waxweiler would not be feasible since adding workers employed at other mills would be difficult, very labor-intensive and costly, and would not increase the size of the cohort dramatically.

3. Cross-sectional study

A cross-sectional medical study would be a good way to evaluate renal and pulmonary disease among uranium millers. Although an update of the mortality study may be able to show whether uranium millers have an increased risk of death **from** renal or pulmonary disease, the mortality study will not be able to detect whether uranium millers are at increased risk of renal and pulmonary disease which is not severe enough to cause death.

One of the major challenges in conducting a good cross-sectional study is identifying a group of uranium millers who are representative of uranium millers in general and a suitable comparison group. Personnel records we found for some mills could possibly be used to assemble a study group but the effort and expense of extracting this information and tracing workers may be considerable. In addition, many of the workers will be deceased and many may no longer live in the local area. Mobility may be less of an issue among Native American uranium millers but we were unable to locate personnel records from mills on the Navajo reservation. Many previous Navajo uranium miners and mill workers have registered with the Office of Navajo Uranium Workers in Shiprock, New Mexico but this registry does not include all previous Navajo uranium millers as there is no incentive for millers to register. We plan to evaluate the records from two other mills; the personnel records from one or both of these mills may be **useful** for assembling a study group.

We concluded that a cross-sectional study of previous uranium millers is feasible but the quality of the study will depend on the ability to identify a representative study population and suitable comparison group. We recommend soliciting proposals and awarding a cooperative agreement for a cross-sectional study evaluating renal and/or pulmonary disease. Miners should not be included in the study since uranium mining could also be associated with non-malignant respiratory disease. If possible, the study group should include various racial/ethnic groups. The study could utilize personnel and/or exposure records accessed by NIOSH but the awardee would be responsible for maintaining the confidentiality of these records as described in the Privacy Act.

SUMMARY

We have evaluated available personnel and exposure records **from** several uranium mills which operated in Colorado, New Mexico, Utah, or Arizona between 1947 and 1971. Based on this evaluation, we recommend updating the Waxweiler study without expanding the study group or adding an exposure assessment component. The incidence of end stage renal disease among the Waxweiler study group could also be assessed. The update of the Waxweiler study will be done by NIOSH and will require a modest investment of funds to validate the work history coding and to update the work histories of people who continued employment after the microfilming was done. We recommend awarding the remaining **funds** by cooperative agreement for a **cross-sectional** study of renal and/or pulmonary disease among surviving uranium millers.

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