

# Frequently Asked Questions: Studies of Causes of Death and Bladder Cancer at a Rubber and Plastics Chemical Manufacturing Company



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## General

### Why was this worksite chosen by NIOSH to study?

In 1988, the union representing workers at the plant asked NIOSH to look into what appeared to be a cluster of bladder cancer cases. A cancer cluster is the occurrence of a greater than expected number of cancer cases in a group of people in a certain area over a period of time. A cancer cluster may be suspected when people report that several family members, friends, neighbors, or coworkers have been diagnosed with the same or related types of cancer.

### What was found in previous studies done by NIOSH at this plant?

- In a study of bladder cancer diagnoses, NIOSH found 13 cases of bladder cancer, while we only expected 3.6 based on rates from the New York State population. Those workers considered to have been definitely exposed to *o*-toluidine and aniline were 6.5 times more likely to get bladder cancer, while those with possible exposure were nearly 4 times more likely to get bladder cancer. Also, as the duration of employment in the department where *o*-toluidine was used increased, the chance of getting bladder cancer also increased.
- In 1990, NIOSH also measured *o*-toluidine and aniline exposures at the plant. The study found that exposed workers had higher levels of *o*-toluidine and aniline in their urine than those who were not exposed. At the end of the workday, levels of aniline in the urine were 7 times higher in workers exposed than those who were not exposed, while the levels of *o*-toluidine were 35 times higher. Also, even those workers considered “unexposed” were exposed to *o*-toluidine and aniline, since the levels in their urine were higher than those that had been reported in the general population.
- NIOSH also did a study of causes of death at the plant. This study found that the group of workers who were mostly assigned to the PVC, Vinyl department were 12 times more likely to die of hepatobiliary cancer than the U.S. population. This study also found that the chance of dying from ischemic heart disease was higher among workers in the rubber chemicals department, though the cause could not be pinpointed.

More information about these studies can be found [here](#).

### Why did you update these studies?

After the initial study, an additional 19 cases of bladder cancer were reported. Company management and the union asked us to update the original study of bladder cancer. Since we did a study of causes of death at the plant in 2000, we thought that it was a good time to update that study as well, to see if there were any changes in causes of death compared to what was found in the earlier study.

### What makes these studies different from past studies of causes of death and bladder cancer at this worksite?

We included more workers. The previous study of bladder cancer done in 1991 and the study of causes of death done in 2000 only included workers hired before 1988. In this study, we included workers hired before 2006 and those who were left out of the original study. We also improved the way we evaluated exposures to the chemicals at the plant (find out more below, under FAQ “How was this study improved?”)

### **What were the workers in these studies like?**

The workers in the study were relatively young, with 74% of the former workers in the study still living as of 2007. The study included 1,812 men and 135 women. The average length of employment at the facility during the study period was about 1 ½ years.

### **Why did you compare workers to the general public?**

We did this to see if workers had higher rates of death or bladder cancer than the U.S. general public. Studies often find that workers are healthier than the general population. This “healthy worker effect” is due to factors such as:

- access to health insurance,
- screening physicals for incoming workers, and
- people who are too ill to work not entering the workforce.

This effect tends to be stronger for non-cancer outcomes like heart disease than for cancers.

### **Why didn't you interview workers or get their medical charts?**

It is extremely important to have the same information for all workers. While medical charts may contain important detailed information, they do not contain the same information for all workers.

We did not interview former workers because in order to have the same information for all workers, we would have had to contact every former worker. It would have been very difficult and costly to locate, contact, and administer a survey to all former workers who were eligible for the study. In addition, it is unlikely that all workers could be located.

### **Why did you only look at some chemicals, when others were also used at the plant?**

We looked at chemicals used at the plant based on the following reasons:

- The union expressed that workers at the plant were worried about getting bladder cancer; we focused on chemicals that could have been linked to bladder cancer, such as *o*-toluidine, aniline and nitrobenzene.
- The union also expressed concern about the occurrence of heart attacks, coronary by-pass operations and elevated cholesterol levels among its members; we studied carbon disulfide and shift work, which have been linked to coronary artery disease.
- Workers at the plant were not originally worried about whether vinyl chloride was linked to hepatobiliary cancers, but vinyl chloride had been studied previously at the plant, and we decided to study it further. Also, at the request of the union, we also evaluated if exposure to vinyl chloride was linked to deaths from other cancers.

### **I am a former worker, and I have one of the diseases that were more common among some workers. Does this mean that my work at the facility caused my disease?**

We cannot tell from this study if someone's cancer or heart disease was caused by their work at the facility. Besides the job exposures you may have encountered at work, there are other factors that may influence whether or not you may have developed a particular disease, such as:

- Personal characteristics such as age, sex, and race
- Family history of cancer or heart disease
- Diet and personal habits such as cigarette smoking and alcohol consumption
- Certain medical conditions
- Exposure to agents that cause disease outside of this workplace

### **What should I do now?**

Please review the recommendations provided to protect your health. If you have questions, talk to your health care provider or contact us at (513) 458-7118 or [GHartle@cdc.gov](mailto:GHartle@cdc.gov). If you are concerned that you are being exposed to a workplace hazard, contact our [Health Hazard Evaluation Program](#).

## Study of causes of death

### Why did you look at deaths and not diagnoses?

Studies of workers in the United States commonly look at deaths because this can be done using existing records. In these studies, deaths are identified by linking a list of workers with national death data. Unfortunately within the United States, there are no national data that can be used to identify workers who were diagnosed with cancer or non-fatal diseases. Cancer diagnoses can be identified from state cancer registries, but workers may have moved to other states and their cancer may not have been entered in a registry used for the study. Learn more about our study of bladder cancer diagnoses using state cancer registry data [here](#).

### Who did you consider exposed to rotating shift work?

Workers in these and other jobs were considered exposed to rotating shift work:

- PVC, Vinyl department:
  - area manager
  - various chemical operators
  - general utility operator
  - various production operators
  - foreman
  - supervisor
- Rubber Chemicals department:
  - area manager
  - antioxidant packaging operator
  - various chemical operators
  - various production operators
  - foreman
  - supervisor

### Who did you consider exposed to vinyl chloride?

We considered any worker assigned to the PVC, Vinyl department before 1995 exposed to vinyl chloride.

Workers in several jobs in other departments were also considered exposed to vinyl chloride, such as:

- Shipping, Packaging & Warehouse
- Rubber Compounds
- Quality Control
- Laboratory
- Research & Development

Workers in many jobs in departments whose work was conducted throughout the plant were also considered exposed to vinyl chloride, such as:

- Maintenance
- Yard/Janitor

Workers in other jobs who moved around the plant were also considered exposed to vinyl chloride, such as:

- Guards
- Nurses
- Engineers
- Yardmen
- Co-op employees
- Workers on temporary assignment from company headquarters
- Jobs with no assigned department prior to 1995

### **Who did you consider exposed to carbon disulfide?**

We considered any worker assigned to the Rubber Chemicals department from 1954 to 1994 exposed to carbon disulfide. We also considered workers in jobs in the PVC, Vinyl department as exposed to carbon disulfide when the job title specifically indicated work in the Rubber Chemicals department. Workers in other departments were also considered to be exposed to carbon disulfide, such as:

- Shipping, Packaging & Warehouse
- Rubber Compounds
- Quality Control
- Laboratory
- Research & Development

Workers in many jobs in departments whose work was conducted throughout the plant were also considered exposed to carbon disulfide, such as:

- Maintenance
- Yard/Janitor

Workers in other jobs were considered exposed to carbon disulfide because they moved around the plant, including:

- Guards
- Nurses
- Engineers
- Yardmen
- Co-op employees
- Workers on temporary assignment from company headquarters
- Jobs with no assigned department prior to 1995

### **If I worked with vinyl chloride, and I'm healthy right now, does this mean that I'll eventually get hepatobiliary cancer?**

We cannot tell from this study whether or not you will get hepatobiliary cancer. However, our study found that workers exposed to vinyl chloride, on average, have a higher chance of getting hepatobiliary cancer compared to the general population.

### **I worked at night and was also exposed to carbon disulfide. Does this mean that I will get coronary artery disease?**

We were not able to tell what caused the elevation of coronary artery disease deaths among workers in this study. Shift work and exposure to carbon disulfide may have played a role, but we cannot tell for sure.

### **Could deaths by coronary heart disease have been caused by smoking?**

Smoking is a known cause of coronary artery disease. But, we found that the number of coronary artery disease deaths among workers at the plant was higher than the number of coronary artery disease deaths that would have been expected from smoking in the New York State population.

### **How do other studies compare to what NIOSH found in this study?**

The findings of this study agree with the earlier NIOSH study that showed a greater chance of death from hepatobiliary cancer in workers at this plant, and agree with other studies on vinyl chloride. The International Agency for Research on Cancer (IARC) has classified vinyl chloride as an agent that causes liver cancer in humans.

## Study of bladder cancer diagnosis

### **Why did you only look at bladder cancer diagnoses and not diagnoses of other cancers?**

The union representing workers at the plant requested that we look into what appeared to be a cluster of bladder cancer cases. We focused on chemicals that could have been linked to bladder cancer.

### **Why doesn't your study include all workers with bladder cancer?**

While we identified 50 cases of bladder cancer through searches in cancer registries in six states (NY, PA, CA, OH, TX, FL), we used 37 in the study; four cases occurred outside the study period of 1976 to 2007 and those remaining did not meet the eligibility requirements of the study. However, the analyses were repeated with the excluded cases and the results did not change. Workers diagnosed with bladder cancer after 2007 or outside of NY, PA, CA, OH, TX, and FL may not have been identified in our study.

### **How was this study improved?**

We improved the way we evaluated exposure to *o*-toluidine, aniline, and nitrobenzene to better examine whether they could be linked to bladder cancer. In the previous study, workers were considered exposed if they worked in certain departments (mainly the Rubber Chemicals Department) for at least a day. In this study, we took into account not only the department, but also the job title and the era when they worked in that department, since the levels of *o*-toluidine, aniline and nitrobenzene in the plant have changed throughout the years. We used this information to rank each worker according to their cumulative exposure to these agents.

### **Were workers involved in this study? If so, how did you use the information they provided?**

Some workers were interviewed. These interviews helped us better understand how likely exposure was in certain department. Through worker interviews, we learned that some of the departments that we had originally considered to be probably not exposed, were actually definitely exposed. One example is the maintenance department. Workers told us that maintenance personnel worked in all areas of the plant making repairs and often would come in contact with liquid chemicals on their hands and clothing.

### **Was bladder cancer linked to any job-related exposures?**

Yes, bladder cancer was more frequent among the workers considered exposed to *o*-toluidine, aniline and nitrobenzene. Among the workers who were likely to be exposed:

- Workers that were definitely exposed regularly at moderate/high levels were almost four times more likely to have bladder cancer than the people of New York State.
- Workers probably exposed regularly at low levels were four times more likely to develop bladder cancer.
- Bladder cancer was also elevated about 2.5 times more among the workers who were probably exposed irregularly/occasionally at low levels compared to the people of New York State.
- Bladder cancer was not increased among the workers who were probably not exposed.

### **Do people with longer exposure have an increased chance of getting bladder cancer? Does the chance increase if the levels of exposure increase?**

We found that as the duration of exposure increased, the chance of getting bladder cancer also increased. In addition, we observed that bladder cancer increased as cumulative exposure increased.

### **What do these findings mean for my family?**

We don't know if workers at this plant carry chemicals from work to home on their clothes and shoes, and on their skin and hair, but we are concerned about this possibility. To avoid this, use the showers provided by the company at the end of your shift, and take advantage of their laundry service. Concerned family members should see their health care provider.

**I work or worked with *o*-toluidine. Does this mean that I will get bladder cancer?**

We cannot tell from this study whether or not you will get bladder cancer. However, our study found that workers exposed to *o*-toluidine, have a higher chance of getting bladder cancer compared to the general population.

**Could smoking be the cause of the increased rate of bladder cancer found in workers at the plant?**

No, smoking was not the major cause of the increased rate of bladder cancer. While smoking is known to be linked to bladder cancer, we took smoking into consideration in our study. We found that the number of cases of bladder cancer among workers at the plant was higher than the number of bladder cancer cases that would be expected from smoking in the New York State population.

**How do the findings compare to the results of other studies?**

This study confirmed the findings of the earlier NIOSH study that workers exposed to *o*-toluidine, aniline and nitrobenzene at this plant have a higher chance of getting bladder cancer. Also, four other studies of workers exposed to *o*-toluidine have found an increase chance of getting bladder cancer. The International Agency for Research on Cancer (IARC) and the National Toxicology Program (NTP) have classified *o*-toluidine as an agent that causes bladder cancer in humans.