

# A Study of **Causes of Death** at a Rubber and Plastics Chemical Manufacturing Company



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This study looked at causes of death in workers at a rubber and plastics chemical manufacturing plant in New York State.

## What we found

### What were the main findings from this study?

- The total number of deaths were about the same as what would be expected from the U.S. population. Among the 1,874 workers in our study, 443 had died. We would have expected 434 based on rates from the U.S. population.
- The total number of deaths from all types of cancer was about the same as what would be expected from the U.S. population. One hundred and twenty one workers died of some type of cancer; we would have expected 112 based on rates from the U.S. population.
- Looking at specific types of cancer, we found hepatobiliary cancer deaths (cancers of the biliary passages, liver, and gallbladder) were more frequent among workers. Eleven people died of hepatobiliary cancer. We would have expected 3 deaths based on rates from the U.S. population. All of the deaths from hepatobiliary cancer occurred in those who were exposed to vinyl chloride before 1974. The longer a person was exposed to vinyl chloride, the more likely they were to have died of hepatobiliary cancer.
- Coronary artery disease deaths were more frequent among workers. One hundred and thirty workers died of coronary artery disease; we would have expected only 105 based on rates from the U.S. population. Coronary artery disease deaths were more frequent in those who were exposed to both rotating shifts and carbon disulfide for four or more years compared to those who were exposed to both for less than four years.

## What this means

### Hepatobiliary cancer

Our findings indicate that hepatobiliary cancer is a concern for workers exposed to vinyl chloride, especially if they worked with it before 1974 or for a long time. An increase in hepatobiliary cancer has been found in other studies of workers exposed to vinyl chloride, and vinyl chloride is now known to cause cancer.

Vinyl chloride has not been used at the plant since 1996. If you worked in the PVC, Vinyl Department before 1996, or suspect that you were exposed to vinyl chloride, see the following [recommendations](#).

### Coronary artery disease

Our findings suggest that coronary artery disease is a concern for some workers. Known risk factors for coronary artery disease include age, family history, smoking, poor diet, high blood pressure, high blood cholesterol levels, diabetes, obesity, physical inactivity, and stress.

Our study and other studies suggest that both shift work and exposure to carbon disulfide may also be linked to coronary artery disease. Because most workers exposed to carbon disulfide in our study worked rotating shifts, we were not able to tell if our findings for coronary artery disease are related to shift work, carbon disulfide, or both. Based on data on smoking in workers and the general population, we do not think smoking is the only reason that coronary artery disease was more frequent than expected.

Carbon disulfide has not been used at the plant since 1994. If you have worked with carbon disulfide or worked on rotating shifts, please see the following [recommendations](#).

## How the study was done

Our study had four steps:

### Step 1. We assembled the study population

We assembled the study population from company records. The earlier study included 1,749 workers employed at the plant for one day or more from 1946 to 1988. In this study, we expanded the study population to also include workers hired after August 1, 1988. This increased the size of the study population to 1,874 workers.

### Step 2. We evaluated each worker's potential job-related exposures

The company did not directly measure exposure to vinyl chloride and carbon disulfide for each worker. This is common in industrial facilities. Because complete individual worker exposure records did not exist, we evaluated each person's potential chemical exposure based on his/her work history through 2007 (e.g., department, job title, how long they held each job).

For this study, we assessed rotating shift work and exposure to two chemicals (vinyl chloride and carbon disulfide). Current and former workers, company management, and union representatives provided valuable input during this process.

### Step 3. We obtained death information

We linked a list of workers in the study with national death data to find out how many workers had died and from what causes. Though we looked at all causes of death, we were most interested in:

- Illnesses that may be linked to rotating shift work based on other studies:
  - Coronary artery disease
  - Breast cancer
  - Colorectal cancer
  - Prostate cancer
  - Non-Hodgkin lymphoma
- Illnesses that may be linked to vinyl chloride based on other studies:
  - Hepatobiliary cancer (cancer of the biliary passages, liver, and gallbladder)
- Illnesses that may be linked to carbon disulfide based on other studies:
  - Coronary artery disease
- Other illnesses of concern to the workers
  - Pancreatic cancer
  - Brain cancer

Because bladder cancer is highly survivable, we looked at bladder cancer diagnoses in a separate study .

### Step 4. We compared causes of death in various groups

To look at the potential link between job exposures and causes of death, we compared death rates in the following groups:

- Workers compared to the general public
- Workers with exposure to rotating shifts, vinyl chloride, or carbon disulfide (based on work histories) compared to workers with no exposure.

## For more information

To learn more about the study, please visit our [Frequently Asked Questions](#), [download a copy of the published manuscript](#), or contact us at (513) 458-7118 or [GHartle@cdc.gov](mailto:GHartle@cdc.gov).

# A Study of **Bladder Cancer Diagnosis** at a Rubber and Plastics Chemical Manufacturing Company

This study looked at bladder cancer diagnosis in workers at a rubber and plastics chemical manufacturing plant in New York State. We studied bladder cancer diagnosis instead of death, because bladder cancer is highly survivable.

## What we found

### **Was bladder cancer more frequent in workers compared to the New York State population?**

Yes, bladder cancer was more frequent among workers. Overall, 50 workers were diagnosed with bladder cancer. Our analysis included 37 bladder cancer cases and we would have expected 13 based on rates from the New York State population.

When we look at groups of workers, according to their potential for exposure to *o*-toluidine, aniline, and/or nitrobenzene:

- Bladder cancer was much more frequent than expected in the workers who were definitely exposed at high levels and in the workers who were probably exposed to low levels regularly.
- Bladder cancer was also more frequent than expected in workers who were probably exposed to low levels occasionally, but it was not as high as in the other groups of exposed workers.
- Bladder cancer was not more frequent among the workers who were probably not exposed.

### **Was bladder cancer more frequent in workers who were exposed to *o*-toluidine, aniline, and/or nitrobenzene for longer periods of time compared to workers exposed for shorter periods of time?**

Yes, workers were more likely to be diagnosed with bladder cancer the longer they were exposed to these chemicals.

### **Was bladder cancer more frequent among workers with more exposure to *o*-toluidine, aniline, and nitrobenzene compared to workers with less exposure?**

Yes, workers with more exposure to these chemicals were more likely to be diagnosed with bladder cancer.

## What this means

Workers exposed to *o*-toluidine, aniline and nitrobenzene are more likely to get bladder cancer. We think *o*-toluidine, rather than aniline or nitrobenzene, is likely the cause because:

- Other studies have found bladder cancer is more frequent in workers exposed to *o*-toluidine. For aniline, some studies have found bladder cancer is more frequent in exposed workers and other studies have not.
- Animal studies have found that aniline and nitrobenzene are less likely to cause cancer than *o*-toluidine.
- Aniline and nitrobenzene were used in smaller quantities in the plant.
- In another study of exposed workers at the plant, the levels of *o*-toluidine found in urine were much higher than the levels of aniline.
- Smoking also causes bladder cancer. Based on data on smoking in the workers and the New York State population, we do not think smoking is the reason bladder cancer was more frequent than expected.

## How the study was done

Our study had four steps:

### **Step 1. We assembled the study population**

We assembled the study population from company records. The original study included 1,749 workers employed at the plant for one day or more from 1946 to 1988. In this study, we expanded the study population to also include workers hired after August 1, 1988. This increased the size of the study population to 1,812 eligible workers.

## Step 2. We evaluated each worker's potential job exposures

We assessed each worker's potential for exposure to *o*-toluidine, aniline, and/or nitrobenzene from work history information in company records (e.g., department, job, how long job held) along with information from NIOSH and company records on how exposure varied across departments, jobs, and time. Because *o*-toluidine, aniline, and nitrobenzene were used at the same time in the same department, we were not able to separate these exposures. Based on this assessment, we placed each worker in one of four exposure groups:

### 1. Workers who were definitely exposed at high levels

These workers worked regularly and in direct contact with *o*-toluidine, aniline, and/or nitrobenzene. Examples include rubber chemical workers and maintenance workers.

### 2. Workers who were probably exposed to low levels regularly

These workers worked regularly around but not in direct contact with *o*-toluidine, aniline, and/or nitrobenzene. Examples include shipping, packaging, and warehouse workers; laboratory technicians; painters; chemical engineers; and co-op workers.

### 3. Workers who were probably exposed to low levels occasionally

These workers worked occasionally around but not in direct contact with *o*-toluidine, aniline, and/or nitrobenzene. Examples include safety engineer; nurse; laboratory supervisor; guard; janitor; yard worker; and shipping, packaging, and warehouse dispatcher.

### 4. Workers who were probably not exposed

These workers did not work around or in direct contact with *o*-toluidine, aniline, and/or nitrobenzene. Examples include accounting staff, secretaries, and switchboard operators.

We also estimated how long each worker had potential job exposure to *o*-toluidine, aniline, and/or nitrobenzene. In addition, we ranked all workers according to how much they were exposed to *o*-toluidine, aniline, and/or nitrobenzene. Current and former workers, company management, and union representatives provided valuable input in this process.

## Step 3. We obtained information on bladder cancer diagnosis

We obtained information on bladder cancer diagnosis from cancer registries in six states:

- New York
- Pennsylvania
- California
- Ohio
- Texas
- Florida

We chose these six states, because 95% of workers lived in one of these states when we did the study.

## Step 4. We compared bladder cancer diagnoses in various groups

To examine the potential link between job exposures and bladder cancer, we compared the rate of bladder cancer diagnoses in the following groups:

- Workers compared to the general population of New York State
- Workers who were exposed to *o*-toluidine, aniline, and/or nitrobenzene for longer periods of time (based on work histories) compared to those who were exposed for shorter periods of time
- Workers with more exposure to *o*-toluidine, aniline, and/or nitrobenzene compared to workers with less or no exposure

## For more information

To learn what you can do to prevent bladder cancer, please see the following [recommendations](#) and visit the NIOSH *o*-Toluidine topic page [www.cdc.gov/niosh/topics/ot](http://www.cdc.gov/niosh/topics/ot).

To learn more about the study, please visit our [Frequently Asked Questions](#), [download a copy of the published manuscript](#), or contact us at (513) 458-7118 or [GHartle@cdc.gov](mailto:GHartle@cdc.gov).

# Recommendations for Improving Worker Health

## Hepatobiliary cancer

We know that vinyl chloride can cause cancer. Vinyl chloride is no longer used at the plant. If you worked with vinyl chloride or worked in the PVC, Vinyl Department (Department 145) before 1996, we recommend that you talk to your health care provider about monitoring your health. There are tests that are being used or studied to screen for liver cancer (but not other forms of hepatobiliary cancer). To learn about these tests, visit the National Cancer Institute webpage on liver cancer screening:

[www.cancer.gov/cancertopics/pdq/screening/hepatocellular/Patient/page3](http://www.cancer.gov/cancertopics/pdq/screening/hepatocellular/Patient/page3).

## Coronary artery disease

The CDC Heart Disease webpage offers information on known risk factors for coronary artery disease and provides information on how to prevent coronary artery disease and other forms of heart disease: [www.cdc.gov/heartdisease/](http://www.cdc.gov/heartdisease/).

Based on the results of our study, exposure to carbon disulfide and rotating shift work may also play a role in coronary artery disease in workers. Carbon disulfide has not been used at the plant since 1994. We recommend taking steps to reduce the impact of rotating shift work on your health, if possible.

There are steps you can take to protect your health from the impact of rotating shift work:

- Sleep on a set schedule to help establish a routine and to make sleep during the day easier.
- Some people may prefer to get a full period of rest just before the next work shift (as it is with “normal day” work). Try different patterns of work and sleep to see which works best for you.
- Make sure that family and friends are aware of and considerate of your sleep hours and needs.
- Try to have a comfortable, dark, quiet place to sleep during the day.
- If you want more information on shift work and ways to manage fatigue and sleepiness, visit the NIOSH Work Schedules webpage: [www.cdc.gov/niosh/topics/workschedules/](http://www.cdc.gov/niosh/topics/workschedules/).

## Bladder cancer

We know that *o*-toluidine can cause cancer. If you work with *o*-toluidine, there are ways you can keep yourself and your family safe.

Use personal protective equipment (PPE) that will keep you from breathing in *o*-toluidine. Keep your skin protected by wearing gloves, protective arm sleeves, lab coats, and boot covers. To learn more about PPE appropriate for protection against *o*-toluidine exposure, visit the NIOSH *o*-Toluidine page on Information for Industrial Workers: [www.cdc.gov/niosh/topics/ot/workers](http://www.cdc.gov/niosh/topics/ot/workers).

Since the worksite offers showers and locker rooms, we recommend that you use them. If you do not shower or if you wear your work clothes home, you can expose your family to chemicals.

If you work or worked in the Rubber Chemicals Department (Department 245), in the Maintenance Department, as a janitor, in the Laboratory and Laboratory QC (Department 104), in the Yard (Department 191) or in Shipping (Department 121), we recommend that you take advantage of the bladder cancer screening program offered by the company. Most people survive bladder cancer if it is detected and treated early.

Semi-annual bladder cancer screening is provided by the company. Active and former employees participating in this program benefit from free testing. If testing indicates a positive result, employees are referred to a urologist and assisted with medical costs.

Smoking is another important cause of bladder cancer. Smokers are more likely to get bladder cancer than nonsmokers. If you smoke, an important way to reduce your chance of developing bladder cancer is to quit. For free help to quit and tips to stay smoke-free, visit the CDC I'm Ready to QUIT! webpage:

[www.cdc.gov/tobacco/campaign/tips/quit-smoking/index.html?s\\_cid=OSH\\_tips\\_D9306](http://www.cdc.gov/tobacco/campaign/tips/quit-smoking/index.html?s_cid=OSH_tips_D9306).

## **The NIOSH Health Hazard Evaluation Program**

If you are concerned that you are being exposed to a workplace hazard, contact our Health Hazard Evaluation Program and request to have your work environment assessed for free. For more details and to fill out a request, visit the NIOSH Health Hazard Evaluation website: [www.cdc.gov/niosh/hhe/](http://www.cdc.gov/niosh/hhe/).