

**Investigation of Aplastic Anemia in Relation
to Concerns about Exposure to Benzene from
a Chemical Plant**

**Cowlitz County, Washington and Columbia
County, Oregon**

August 2006 – December 2007

Investigation of Aplastic Anemia in Relation to Concerns about Exposure to Benzene from a Chemical Plant

Cowlitz County, Washington and Columbia County, Oregon

August 2006 – December 2007

Final Report, March 2008

Cluster investigation team (alphabetical order):

Hilary Gillette-Walch, R.N., M.P.H., Cowlitz County Health Department
Michael Heumann, M.P.H., M.A., Oregon State Public Health Division
Kathryn J. Hughes, M.P.H., Washington State Department of Health
Richard F. Leman, M.D., Oregon State Public Health Division
Steven C. Macdonald, Ph.D., M.P.H., Washington State Department of Health
Dave Stone, Ph.D., Oregon State University
Juliet VanEenwyk, Ph.D., M.S., Washington State Department of Health

Consultants (alphabetical order):

Judy Bardin, Sc.D., Washington State Department of Health
Dave Bonauto, M.D., M.P.H., Washington State Department of Labor and Industries
George Davis, Environmental Engineer, Oregon Department of Environmental Quality
Mimi Fields, M.D., Cowlitz County Health Department
Hope Hough, Health Services Consultant, Washington State Department of Health
Matt Kadlec, Ph.D., Washington State Department of Ecology
David W. Kaufman, Sc.D., Slone Epidemiology Center at Boston University
Paul T. Mairose, P.E., Southwest Clean Air Agency
Dave McBride, M.S., Washington State Department of Health
Glen Patrick, Ph.D., Washington State Department of Health
Catherine A. Riddell, Oregon State Public Health Division
John St. Clair, M.S., Southwest Clean Air Agency
Ha Tran, Environmental Engineer, Washington State Department of Ecology
Theodora A. Tsongas, Ph.D., M.S., Oregon State Public Health Division
Carolyn Whitaker, M.S., C.I.H., Washington State Department of Labor and Industries
Julie Wroble, Toxicologist, U.S. Environmental Protection Agency

We thank the Cowlitz and Columbia County residents who provided health information to aid this effort.

For more information, in Oregon, contact Richard Leman, 971-673-0984 or by e-mail at richard.f.leman@state.or.us. In Washington, contact Steve Macdonald, 360-236-4253 or by e-mail at steven.macdonald@doh.wa.gov.

EXECUTIVE SUMMARY

Background and Introduction

In August 2006, a citizen called the Washington State Department of Health, the Oregon State Public Health Division and the Cowlitz County Health Department to report six people diagnosed with aplastic anemia between 1999 and 2006. All six had lived in Cowlitz County, Washington or Columbia County, Oregon during relevant time periods prior to diagnosis. Most lived in the Longview/Kelso area of Washington State, which is the major population center in the two counties. The citizen was concerned that the diagnosis of six people with aplastic anemia in a relatively small population was unusual. The citizen also expressed concern that these illnesses might have been caused by exposure to benzene from the Emerald Kalama Chemical plant in Kalama, Washington. The plant, which releases benzene into the air each year, is located in Cowlitz County, Washington just across the Columbia River from Columbia County, Oregon.

Occupational studies have established that benzene can cause aplastic anemia. Benzene can also cause acute myeloid leukemia (AML) and might cause other types of leukemia as well. In addition to exposure to benzene, all of these conditions have other possible causes and for most people with these conditions, the cause is not known. Benzene is present in gasoline and some cleaning solvents and is released during most burning processes (for example, use of wood stoves and burning of cigarettes). Thus, exposure to benzene is common. However, documented development of aplastic anemia as a result of such exposure is rare. The reasons why some people are more susceptible to the harmful health effects of benzene remain unknown.

Methods

After receiving the citizen report, the Oregon State Public Health Division, the Washington State Department of Health and the Cowlitz County Health Department conferred with each other, and decided to initiate an investigation. The goals of our investigation were the following:

- Determine if there were more people with aplastic anemia and other health conditions associated with benzene exposure among residents of Cowlitz and Columbia Counties than would be expected, given the background rates of these diseases and population sizes of the two counties
- Determine the potential for exposures to benzene from Emerald Kalama to have caused these illnesses

We then conferred with personnel from state and local environmental agencies and the Washington State Department of Labor and Industries to determine availability of data pertaining to the concern and to assign responsibility for compiling and analyzing data. We subsequently obtained health and environmental data from many of these agencies, as well as from individuals identified in the initial report and from Emerald Kalama. We reviewed the relevant literature and also consulted with Dr. David Kaufman, a recognized expert on aplastic anemia from Boston University, for background information used to guide the investigation.

Results

- Over a ten-year period, seven people in the two counties were diagnosed with aplastic anemia. Given the size of the population, we would expect three cases of aplastic anemia, with a range, based on random variation, of zero to six. The seven people represent one more than would be expected based on random variation. No specific exposures or risk factors were identified.
- There were no statistically significant increases in aplastic anemia deaths or in new cases of acute myeloid leukemia (AML) in the two counties. This means that the numbers of observed cases of these conditions were not higher than we would expect based on random variation.
- Over the ten years, 193 people developed some form of leukemia. We would expect 163 cases with a range, based on random variation, of 139 to 189 for the two-county area as a whole. The 193 people represent four more than might be expected, based on random variation.

- If benzene from Emerald Kalama was causing leukemia in the surrounding communities, we would have expected to see an increase in AML diagnoses, since AML is the type of leukemia most strongly linked to benzene exposure, but this was not the case.
- Because Emerald Kalama employees would likely experience greater benzene exposure than community members, the absence of blood-related disorders among these workers in Washington Dept. of Labor and Industry databases supports the conclusion that exposure to benzene from the plant is unlikely to be causing such disorders in the community.
- Emerald Kalama and other point sources are not major contributors to airborne benzene in the two counties. The biggest contributors are vehicle exhaust and area sources such as wood stove burning. The amounts of benzene released during acute events at Emerald are usually small and would not substantially increase emissions on a typical day.
- Given predominant wind patterns and the population distribution of the two counties, the locations where the people with aplastic anemia lived at the relevant times prior to diagnosis do not support the hypothesis that benzene air emissions from the plant are causing illness among community members.
- The potential for harmful amounts of benzene to reach groundwater off-site at Emerald Kalama appears to be low. Consistent with this hypothesis, samples from public drinking water supplies in Cowlitz and Columbia Counties did not reveal detectable levels of benzene (with the exception of two wells in Cowlitz County located in a direction where groundwater from beneath the plant does not flow).

Conclusions

Because aplastic anemia might represent a rare reaction to a common exposure, it is impossible to say for sure whether any individual's aplastic anemia was or was not caused by exposure to benzene, either from Emerald Kalama or any other specific source. Based on the findings of this investigation, over a ten-year period, one additional person developed aplastic anemia beyond what would reasonably be attributed to chance, given the usual rate of disease and the number of people living in the area. There was also a small elevation in the number of people with leukemia, although not of the type most commonly associated with benzene exposure.

Additional health data, as well as air and water data reviewed for this report do not support the conclusion that benzene released from Emerald Kalama is the cause of the majority of aplastic anemia cases in Cowlitz and Columbia Counties. At this time, the agencies and organizations involved to date agree that further investigation is unlikely to find a focal cause of the cases of aplastic anemia occurring in Cowlitz and Columbia County residents. While there is no hard evidence that any specific benzene source was the cause of illness in the people we interviewed, there is strong evidence that exposure to this chemical can cause life-threatening illnesses such as aplastic anemia and cancer. Therefore, decreasing exposure to benzene in the general population by lowering the amount of this compound in petroleum products would help protect the public's health. The agencies will assess the need for further investigation as new information becomes available.

