Polycythemia Vera Cancer Cluster Investigation in Northeastern PA

Environmental exposure assessment of air pollutants for the polycythemia vera cluster in northeastern Pennsylvania

Background

Polycythemia vera (PV) is a rare blood cancer that results in the overproduction of red blood cells. The cause of PV is unknown; however, a specific genetic mutation is associated with the disease. The acquired mutation, *JAK2V617F*, is present in approximately 97% of PV patients. In 2008, the World Health Organization included the *JAK2V617F* mutation as part of the major criteria for diagnosing PV.

The purpose of this study was to evaluate present and past exposures of residents living in the PV cluster area in northeastern Pennsylvania (Carbon, Luzerne, and Schuylkill counties) to specific air pollutants from local and regional sources. The PV cluster area is approximately 200 square miles and has a population of about 75,000.

What Was Studied

In 2006, Pennsylvania Department of Health asked ATSDR to help study PV patterns among residents in northeastern Pennsylvania. ATSDR reviewed medical records, conducted genetic testing for the *JAK2V617F* mutation, and confirmed the presence of a PV cluster at the center of three counties (Carbon, Luzerne, and Schuylkill) in northeastern Pennsylvania.

In 2009, ATSDR received funding to continue the PV cancer cluster investigations. In this component of the overall PV investigation, ATSDR asked the contractor* to evaluate the potential exposures of residents of the three counties to air pollutants from local and regional sources and to consider if air quality could be connected to the PV cluster in the area. ATSDR specifically asked the contractor to:

- create an inventory of regional sources of air pollution
- examine historical air emissions from past operations of area Superfund sites
- review data from ambient air monitoring stations in northeastern Pennsylvania
- conduct air modeling of selected air pollution sources
- conduct ambient air testing

Air pollutants

Criteria pollutants are six commonly found air contaminants (ground-level ozone, carbon monoxide, sulfur oxides, nitrogen oxides, and lead).

Hazardous air pollutants (HAPs) are a list of 189 air contaminants that are known or suspected to cause cancer or other serious health effects, such as birth defects or known or suspected to cause adverse environmental effects.

- *ATSDR awarded a contract to Equity Environmental Engineering LLC to conduct the study.

Gathering and Analyzing Data

- *Inventory of area sources of air pollution*

  To identify sources of air emissions in the tri-county cluster area, the contractor searched various databases containing publicly available information about facilities regulated by federal and state authorities. The contractor compiled a list of nearly 1,000 sources of air emissions in the tri-county area, including air emission sources for 1987–2009. Types of air emissions sources identified included waste coal fired cogeneration facilities, commercial printing operators, metal recyclers, landfills, dry cleaners, airports, and water treatment facilities. Most of the sources were located in Luzerne County (62%), followed by Schuylkill (32%) and Carbon counties (5%).

  Of the identified air emission sources, 75 were selected for further evaluation based on the type and number of chemicals they emitted. Selected facilities were those that emitted 20 or more tons per year of criteria pollutants and/or volatile organic compounds (VOCs) or that emitted one or more tons per year of hazardous air pollutants.

  The contractor summarized information about these 75 emission sources by facility name, location, industrial activity, and operational period. Type and quantity of chemicals emitted were summarized if available. Information from these emission sources was then used for the air dispersion modeling task.

- *Historical air emissions from past operation of area Superfund sites*

  The contractor reviewed historical air emissions from former operations at Superfund National Priority List sites in the tri-county area, identifying six Superfund National Priority List (NPL) sites within the tri-county cluster area: C&D Recycling (Luzerne County), Eastern Diversified Metals (Schuylkill County), Metropolitan Mirror & Glass Inc. (Schuylkill County), McAdoo Associates (Schuylkill County), Tonolli (Carbon County), and Valmont TCE (Luzerne County). Past releases of hazardous chemicals into the environment, including VOCs, particulates, and metals such as arsenic, cadmium, cyanide, lead, and manganese, were associated with each of these facilities. Researchers concluded that the historical records did not contain enough information to quantify past air emissions from the Superfund NPL sites and any associated air exposures of area residents.

- *Review of data from ambient air monitoring stations*

  The contractor identified and reviewed summary reports on ambient air data collected by the Pennsylvania Department of Environmental Protection (PADEP) within and around the tri-county cluster area for the years 1980-2009. The contractor identified one ambient air station monitoring for criteria air pollutants in the tri-county area. The contractor found no ambient air stations monitoring for air toxics in the cluster area and instead used data collected from the nearest ambient air toxics monitoring station, in Centralia, Columbia County, Pennsylvania. Review of the available ambient air monitoring data from within and around the tri-county cluster area did not identify any significant hazardous air pollutants of concern.

- *Conduct air modeling of selected sources of air pollution*

  The contractor used air dispersion modeling (computer simulations) to predict ambient air concentrations of pollutants around the tri-county cluster area. Air modeling is one approach used to try to understand the potential for air exposures when air monitoring information is lacking. To run air dispersion models, information about potential air emission sources in the area must be available. For many of the identified sources of air emissions, there was not enough site-specific emissions information to include in the modeling effort.

The contractor's air modeling simulations used "worst case" air emissions data from targeted sources that had enough information to include in the model. The air emissions data selected for the modeling runs represented the maximum documented quantities and time durations. The computer simulations predicted the highest concentrations of particulate matter and volatile organic compounds in ambient air around the cluster area. Additionally, the contractor considered meteorological conditions, nearby buildings, and terrain and also compared air emissions sources in both the study area and a region upwind of the study area for comparison.

The results of the air dispersion modeling were used to evaluate inhalation effects of the modeled (estimated) concentrations. The researchers concluded that the predicted air concentrations of chemicals from the modeling were below levels of public health concern. The predicted air concentrations were compared to EPA's Risk Based Screening Levels for cancer and non-cancer health effects.

- ***Conduct ambient air testing***

The contractor collected three 24-hour ambient air samples from two locations—the Tuscarora State Park and the Weatherly Borough Building—over a three-day period in August 2012, and evaluated the samples for VOCs, total suspended particulates, and metals. The average concentrations of the chemicals detected in the samples were below levels of public health concern.

Conclusion and Key Results

An inventory of more than 1,000 regional air pollution sources operating from 1987 through 2009 was identified in the tri-county area; 75 of these sources were identified as significant sources of air emissions. Key findings were these:

- The historical records did not contain enough information to quantify historical air emissions or associated air exposures from the six Superfund National Priority List sites in the tri-county area.
- Currently, ambient air quality of the tri-county study area meets federal air quality standards for criteria air pollutants.
- Average air concentrations of metals and VOCs measured by the contractor during the August 2012 air monitoring period were below levels of health concern.
- The contractor's review of the available air monitoring information for criteria air pollutants and air toxics did not identify significant air pollutants of concern. Ambient air data collected from these monitoring stations were compared to National Ambient Air Quality Standards.

Predicted concentrations of air pollutants in the PV study area were below levels of public health concern.

- Using data from numerous sources, the contractor developed an air dispersion model.
- Predicted concentrations were below EPA's Risk Based Screening Levels for cancer and non-cancer health effects.

Study Limitations

The current study had several limitations. The air emissions inventory used for this study did not include information from before the late 1980s; pollution control and reporting of air emissions were not required prior to that period. Air emissions in the past were likely higher than they were once air emission controls became more widely used and reporting was required. Assessment of air toxics in ambient air data was

limited to a single air monitoring station located upwind and outside of the tri-county cluster area. The study's air sampling effort was limited to two locations from a very large study area. In addition, the effort was for a short duration and for a limited list of compounds. Current air monitoring in the tri-county study area is of limited use for long-term historical exposure assessment and evaluation related to the PV cluster. Many of the major air emissions sources identified in the air emissions inventory for this area have been removed, idled, controlled, or modified.

While the list of air emissions sources was extensive, many of the air emissions sources identified did not have enough site-specific emissions data available to include in the air modeling exercise. The contractor's assessment did not include potential exposures to indoor air contaminants (e.g., radon, coal fire by-products) and to some criteria pollutants (i.e., nitrogen oxide, sulfur dioxide, ozone, and carbon monoxide). Long-range transport of air emissions from beyond the regional area and occupational exposures also were not evaluated.

For More Information

Visit ATSDR's Web page on PV: http://www.atsdr.cdc.gov/sites/polycythemia_vera/index.html.

Call ATSDR's toll-free PV information line at 866-448-0242 or email Dr. Elizabeth Irvin-Barnwell, ATSDR Division of Toxicology and Human Health Sciences, at jcx0@cdc.gov.

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