A Comprehensive Review of Occupational and General Population Cancer Risk: 1,3-butadiene Exposure-response Modeling For All Leukemia, Acute Myelogenous Leukemia, Chronic Lymphocytic Leukemia, and Chronic Myelogenous Leukemia

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Abstract

Excess cancer risks associated with 1,3-butadiene (BD) inhalation exposures can be calculated using an extensive data set from the University of Alabama at Birmingham (UAB) from an epidemiology study of North American workers in the styrene butadiene rubber (SBR) industry. While the UAB study followed SBR workers, risk calculations can be adapted to estimate both occupational and general population risks. The data from the UAB SBR study offers an opportunity to quantitatively evaluate the association between cumulative exposure to BD and cancer, accounting for the number of tasks involving high-intensity exposures to BD. In addition, the UAB SBR study can be used to quantitatively evaluate associations between exposures to BD and cancer and also account for confounding associated with the exposures to the multiple other chemicals in the SBR industry. Quantitative associations of BD exposure and cancer, specifically leukemia, can be further characterized by leukemia type, including potential associations with acute myelogenous leukemia (AML), chronic lymphocytic leukemia (CLL), and chronic myelogenous leukemia (CML), and the groups of lymphoid and myeloid neoplasms. Collectively, these multiple opportunities for evaluation in the UAB SBR study allows for a comprehensive analysis that can optimize the information to be consistent with the risk assessment goals of the US EPA and other regulatory agencies, and in line with the recommendations of the US EPA Science Advisory Board. While a range of cancer risk values can result from these multiple factors, a preferred case for occupational and general population risk will be highlighted.

Cox proportional hazards model were used to fit exposure-response models to the most recent UAB data. The slope of the model is not statistically significantly different from zero for CML, AML, or, when any one of eight exposure covariates is added to the model, for all leukemias combined. The slope for CLL is statistically significantly greater than zero. The excess risk for the general population is largest for all leukemias combined, and the EC(1/100,000) is approximately 0.15 BD environmental ppm. The models were also fit to lymphoid neoplasms and myeloid neoplasms data. The slope for myeloid neoplasms was not statistically significantly greater than zero while the slope for lymphoid neoplasms was statistically significantly greater than zero. The best estimates of excess risk by age 70 years and occupational BD exposure from 20 to 65 years of age for lymphoid neoplasms, leukemias and CLL are EC(1/10,000)'s of 3.1, 9.2 and 13 ppm, respectively.