

## Commitment to Research

To add to the scientific understanding of formaldehyde, the Foundation has supported research in three critical data streams. Foundation research has included reviews of human epidemiological studies, which provide information on possible distribution of health effects in the population; toxicology studies conducted in laboratory animal models, which use controlled exposures to provide information about possible impacts and relevance to humans; and evaluations of mode of action information, which help us understand the mechanism by which a chemical could act in the human body. Once information is gathered and assessed from each of these data streams, it can be integrated into chemical assessments to build science based understanding of possible health impacts. Below are several research projects that have been supported by the Foundation, which address each of these areas.

### I. Epidemiological Evidence

- Mundt, Kenneth, Alexa Gallagher, Linda Dell, Ethan Natelson, Paolo Boffetta, and Robinan Gentry. [Does occupational exposure to formaldehyde cause hematotoxicity and leukemia-specific chromosome changes in cultured myeloid progenitor cells?](#) Critical Reviews in Toxicology. (2017) 47(7): 592-602.
- Marsh, Gary M., Peter Morfeld, Sarah D. Zimmerman, Yimeng Liu, and Lauren C. Balmert. [An updated re-analysis of the mortality risk from nasopharyngeal cancer in the National Cancer Institute formaldehyde worker cohort study.](#) Journal of Occupational Medicine and Toxicology. (2016) 11(1): 8.
- Checkoway, Harvey, Linda D. Dell, Paolo Boffetta, Alexa E. Gallagher, Lori Crawford, Peter SJ Lees, and Kenneth A. Mundt. [Formaldehyde exposure and mortality risks from acute myeloid leukemia and other Lymphohematopoietic Malignancies in the US National Cancer Institute cohort study of workers in Formaldehyde Industries.](#) Journal of Occupational and Environmental Medicine. (2015) 57(7): 785.
- Marsh, Gary M., Peter Morfeld, James J. Collins, and James Morel Symons. [Issues of methods and interpretation in the National Cancer Institute formaldehyde cohort study.](#) Journal of Occupational Medicine and Toxicology (2014) 9(1): 1.
- Checkoway, Harvey, Paolo Boffetta, Diane J. Mundt, and Kenneth A. Mundt. [Critical review and synthesis of the epidemiologic evidence on formaldehyde exposure and risk of leukemia and other lymphohematopoietic malignancies.](#) Cancer Causes & Control (2012) 23(11): 1747-1766.

### II. Toxicology and Mode of Action Evidence

- Albertini, Richard J., and Debra A. Kaden. [Do chromosome changes in blood cells implicate formaldehyde as a leukemogen?](#) Critical Reviews in Toxicology (2017) 47(2): 145-184.
- Lai, Yongquan, Rui Yu, Hadley J. Hartwell, Benjamin C. Moeller, Wanda M. Bodnar, and James A. Swenberg. [Measurement of endogenous versus exogenous](#)



[formaldehyde-induced DNA-protein crosslinks in animal tissues by stable isotope labeling and ultrasensitive mass spectrometry](#). *Cancer Research* (2016) 76(9): 2652-2661.

- Yu, Rui, Yongquan Lai, Hadley J. Hartwell, Benjamin C. Moeller, Melanie Doyle-Eisele, Dean Kracko, Wanda M. Bodnar, Thomas B. Starr, and James A. Swenberg. [Formation, accumulation, and hydrolysis of endogenous and exogenous formaldehyde-induced DNA damage](#). *Toxicological Sciences* (2015) 146(1): 170-182.
- Rager, Julia E., Benjamin C. Moeller, Sloane K. Miller, Dean Kracko, Melanie Doyle-Eisele, James A. Swenberg, and Rebecca C. Fry. [Formaldehyde-associated changes in microRNAs: tissue and temporal specificity in the rat nose, white blood cells, and bone marrow](#). *Toxicological Sciences* (2014) 138(1): 36-46.
- Rager, Julia E., Benjamin C. Moeller, Melanie Doyle-Eisele, Dean Kracko, James A. Swenberg, and Rebecca C. Fry. [Formaldehyde and epigenetic alterations: microRNA changes in the nasal epithelium of nonhuman primates](#). *Environmental Health Perspectives* (2013) 121(3): 339-344.
- Lu, Kun, Sessaly Craft, Jun Nakamura, Benjamin C. Moeller, and James A. Swenberg. [Use of LC-MS/MS and stable isotopes to differentiate hydroxymethyl and methyl DNA adducts from formaldehyde and nitrosodimethylamine](#). *Chemical Research in Toxicology* (2012) 25(3): 664-675.
- Moeller, Benjamin C., Kun Lu, Melanie Doyle-Eisele, Jacob McDonald, Andrew Gigliotti, and James A. Swenberg. [Determination of N 2-hydroxymethyl-dG adducts in the nasal epithelium and bone marrow of nonhuman primates following 13CD2-formaldehyde inhalation exposure](#). *Chemical Research in Toxicology* (2011) 24(2): 162-164.

### III. **Chemical Assessment**

- Golden, Robert and Stewart Holm. Indoor Air Quality and Asthma: [Has Unrecognized Exposure to Acrolein Confounded Results of Previous Studies?](#). *Dose Response*. (2017) Jan-Mar 2017: 1-9.
- Starr, Thomas B., and James A. Swenberg. [The bottom-up approach to bounding potential low-dose cancer risks from formaldehyde: an update](#). *Regulatory Toxicology and Pharmacology* (2016) 77: 167-174.
- Rhomberg, Lorenz R. [Contrasting directions and directives on hazard identification for formaldehyde carcinogenicity](#). *Regulatory Toxicology and Pharmacology* (2015) 73(3): 829-833.
- Starr, Thomas B., and James A. Swenberg. [Response to Crump et al.](#) *Regulatory Toxicology and Pharmacology* (2014) 70(3): 737.
- Swenberg, James A., Benjamin C. Moeller, Kun Lu, Julia E. Rager, Rebecca C. Fry, and Thomas B. Starr. [Formaldehyde Carcinogenicity Research 30 Years and Counting for Mode of Action, Epidemiology, and Cancer Risk Assessment](#). *Toxicologic Pathology* (2013) 41(2):181-189.



- Gentry, P. Robinan, Joseph V. Rodricks, Duncan Turnbull, Annette Bachand, Cynthia Van Landingham, Annette M. Shipp, Richard J. Albertini, and Richard Irons. [Formaldehyde exposure and leukemia: Critical review and reevaluation of the results from a study that is the focus for evidence of biological plausibility](#). Critical Reviews in Toxicology (2013) 43(8): 661-670.
- Starr, Thomas B., and James A. Swenberg. [A novel bottom-up approach to bounding low-dose human cancer risks from chemical exposures](#). Regulatory Toxicology and Pharmacology (2013) 65(3): 311-315.
- Golden, Robert. [Identifying an indoor air exposure limit for formaldehyde considering both irritation and cancer hazards](#). Critical Reviews in Toxicology (2011) 41(8): 672-721.
- Rhomberg, Lorenz R., Lisa A. Bailey, Julie E. Goodman, Ali K. Hamade, and David Mayfield. [Is exposure to formaldehyde in air causally associated with leukemia?—A hypothesis-based weight-of-evidence analysis](#). Critical Reviews in Toxicology (2011) 41(7): 555-621.

