

Update on Isocyanates

On April 3rd and 4th, 2013, multiple governmental agencies, such as NCI, NIEHS, NIOSH, ATSDR and professional organizations, such as ATS, ACOEM, ACGIH sponsored an International Conference in Bethesda, Maryland titled “Isocyanates and Health”.

Isocyanates are low molecular weight, highly reactive compounds that are widely used in industrial and consumer products. They are the most common causes of work-related asthma both in Michigan and worldwide. Four hundred and twenty workers have been diagnosed and reported to the Michigan surveillance program with work-related asthma from isocyanates since 1988.

Aliphatic diisocyanates, i.e. HDI, are used in coatings and paints such as on cars because of their resistance to wear. Aromatic diisocyanates, i.e. MDI and TDI are used in foams (chairs and auto seats) adhesives, sealants (i.e. urethane), elastomers and insulation (i.e. blown in foam). Commercial products contain multiple isomers and oligomers of these substances, some of which will not be captured with current air sampling techniques. Production of these products involves mixing the isocyanate with a catalyst, typically an amine compound, which reacts with the $-N=C=O$ functional group on the isocyanate to form the product, a polymer. During the curing of the product there is some off gassing of unreacted isocyanate. Paints take more time to cure than the aromatic isocyanates used in the making of foam. Exposure and sensitization to isocyanates occurs from their inhalation and probably also from skin contact.

Use of isocyanates in Michigan is widespread and is increasing. In 2011, 103 Michigan companies reported to the EPA they used at least 10,000 pounds a year compared to 94 companies in 2009. These 103 companies are larger manufacturers making adhesives, laminated wood products, vehicle paint, insulation products, and auto parts such as seats, head and arm rests, painting during vehicle assembly or foundries that use isocyanates to make sand cores. Up to 30,496 or almost 1% of the Michigan workforce is potentially exposed to isocyanates in these facilities. This estimate does not include employees in smaller facilities such as auto body/repair shops, home insulators and other construction workers, and spray-on truck bed liner applicators whose employers are not required to report isocyanate usage to the EPA. Table 14 in our recent Work-Related Asthma Annual report lists the 103 companies by county that reported using at least 10,000 pounds of isocyanates per year (www.oem.msu.edu/annualreports.aspx).

The conference covered five major topics; 1) worker and consumer exposure issues; 2) pathological mechanisms; 3) blood and urine biomarkers of exposure; 4) air and dermal sampling issues; and 5) medical surveillance.

WORKER AND CONSUMER EXPOSURE ISSUES

Potential consumer issues discussed at the conference included exposure from spray foam home insulation and foam mattress or pillows. Assuming the homeowners were out of the home during application there would be no isocyanate exposure to the homeowners. However, some homeowners are reporting irritative symptoms of the eyes and nose and cough. This can occur after incorrect applications that cause release of amines, the catalyst mixed with the isocyanates. Persistent odors more than four days after the application, and application in warmer months are associated with increased irritative symptoms. Similarly, with foam mattresses and pillows, exposure from the amine catalyst rather than the isocyanates was the chemical of concern. In both scenarios the isocyanates would have already reacted and there would be no isocyanate exposure.

PATHOLOGICAL MECHANISM

Mechanisms for sensitization to isocyanates, particularly with MDI, from skin contact, animal models and non IgE related mechanisms for sensitization were discussed. IgE specific antibodies are present less than 30% of the time and there is no increase in IL4 in asthma caused by isocyanates.

BLOOD AND URINE BIOMARKERS

There was discussion of the lack of a good correlation between metabolites of the isocyanates and air or dermal sampling. Data was presented on the use of IgG antibodies, measured with ELISA laboratory methodology, as a marker of exposure. The isocyanate IgG antibody test clinically available through commercial laboratories is not performed using ELISA and was not felt to be useful as it is both less sensitive and less specific than the ELISA methodology.

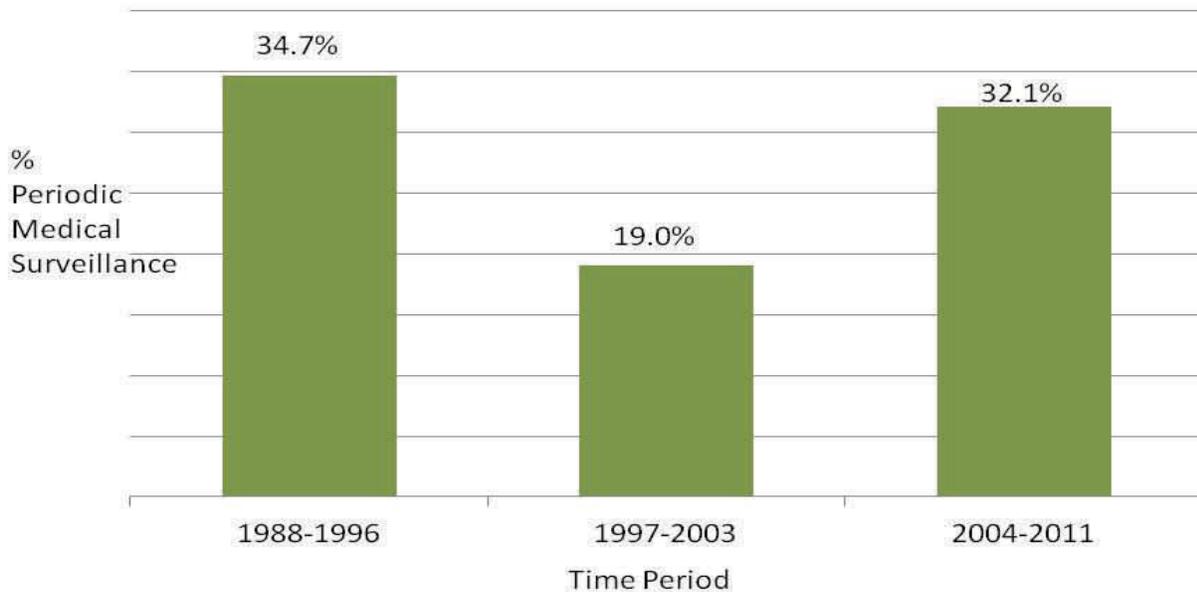
AIR AND DERMAL SAMPLING

Concern was raised that current sampling techniques do not capture the isocyanate in the air or on the skin. Some air sampling methods only capture isocyanate in a gas form and miss particulates. There was discussion of the pluses and minuses of an approach that measured the total isocyanate load, to capture all isomers and oligomers, but that did not measure specific isocyanates.

MEDICAL SURVEILLANCE

The benefits of medical surveillance by companies working with isocyanates were highlighted. Medical surveillance reduces morbidity and increases the number of individuals whose asthma completely resolves with cessation of exposure. Data presented showed that a symptom questionnaire was the most valuable component of a medical surveillance program with follow up breathing tests and referral to an expert for individuals identified with respiratory symptoms on the questionnaire. The value of routine periodic spirometry was questioned. A presentation made of the experience in Michigan showed that despite the recommendations about providing medical surveillance only 30% of Michigan companies were providing surveillance and that this percentage had not improved over the last 25 years (Figure 1).

Figure 1. Percent of Isocyanate Using Companies Providing Periodic Medical Surveillance for their Employees, Michigan 1988-2011



WE REMAIN VERY INTERESTED IN HEARING ABOUT YOUR PATIENTS WHO YOU SUSPECT HAVE DEVELOPED ASTHMA FROM ISOCYANATES EITHER AT WORK OR AT HOME. THERE HAVE BEEN TWO DEATHS IN MICHIGAN FROM ISOCYANATE INDUCED ASTHMA AND HEALTH CARE PROVIDERS NEED TO BE PARTICULARLY CAREFUL ABOUT CONTINUED EXPOSURE IN PATIENTS WHO HAVE BECOME SENSITIZED TO AN ISOCYANATE. DR. KENNETH ROSENMAN AT 1-800-446-7805 IS AVAILABLE TO DISCUSS CONCERNS RELATED TO DIAGNOSIS AND MANAGEMENT.

Comprehensive List of the Causes of Work-Related Asthma

A patient tells you that their asthma symptoms are worse in relationship to work and are better or go away on weekends and/or vacations. They tell you the name(s) or bring in the Material Safety Data Sheets (MSDS)* of the substances they work with. To find out if the substance(s) are known to cause sensitization and work-related asthma go to the Association of Occupational and Environmental Clinics web site at <http://www.aoecdata.org/ExpCodeLookup.aspx>

This is the most comprehensive source of known work-related allergens and is regularly updated. There are 310 known work-related asthma causing substances listed on the website. If you are interested in obtaining medical literature related to a specific substance or have questions about what levels of exposure can cause asthma, please call Kenneth Rosenman, MD at 1-800-446-7805 to discuss.

*U.S. regulations require that every chemical used in the United States have a MSDS which describes safe handling procedures and the adverse health effects of the substance. Chemical manufacturers are required to give treating health care providers the names of all the ingredients of the product even if the ingredients are trade secrets.

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*Project
S Remember to report all cases of occupational disease!

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