Unraveling the mystery of arsenic's *modi operandi*

Dr. Miroslav Stýblo

Murder mysteries have given arsenic a sinister reputation, but the damage it does is no fiction.

The naturally occurring compound is the most harmful human carcinogen, says Miroslav Stýblo, PhD, associate professor of nutrition at UNC Gillings School of Global Public Health. It affects between 60 million and 100 million people around the world, most of whom are exposed by drinking water that has passed through geological formations containing arsenic.

"We have good evidence that links chronic arsenic exposure to cancers of the skin, bladder, lungs and possibly the liver," Stýblo explains. "It can also cause a spectrum of other diseases—cardiovascular disease, diabetes and probably many others."

Stýblo's Gillings Innovation Lab has taken a two-pronged approach to the problem. One objective is to develop techniques sensitive enough to detect arsenic in very small tissue samples.

The other goal is to analyze how arsenic is metabolized in human tissues into compounds more toxic than those found in drinking water.

The basic method for detecting arsenic in human tissue was developed some time ago. But researchers struggle with several challenges, primarily that the most toxic forms of arsenic disintegrate when exposed to air. Consequently, handling samples has been a stumbling block. The problem is compounded because areas where arsenic exposure is most widespread—primarily Southeast Asia, Bangladesh and the West Bengal region of India—tend to be rural and less developed.

In 2009, Stýblo's team designed a customized lab at UNC that integrates and modifies the work of two researchers in Prague, Jiří Dědina and Tomáš Matoušek of the Institute of Analytical Chemistry of the Academy of Sciences of the Czech Republic. Together, they have developed an innovative and inexpensive approach that uses very small samples. While fine-tuning the technique, they are sharing it with three laboratories in Mexico, another country where arsenic causes widespread harm.

Now Stýblo's lab is tackling its second challenge, analyzing the toxic compounds created when the human body metabolizes arsenic. Researchers previously have analyzed urine samples to determine arsenic exposure, but such samples can't tell us what arsenic does when it remains in human tissue.

> Stýblo is developing new ways to discern how arsenic impacts the human lungs and bladder.

Stýblo and his team are developing new ways to discern arsenic's impact on the lungs and bladder. Andrew J. Ghio, MD, medical officer in the U.S. Environmental Protection Agency's Human Studies Division, leads a UNC-based study that provides Stýblo's lab with epithelial cells from the airways of smokers exposed to arsenic in cigarette smoke. Two researchers in Mexico, Luz María Del Razo of the Research and Advanced Studies Center of the National Polytechnic Institute of Mexico (Cinvestav–IPN) and Gonzalo García Vargas of Universidad Juarez del Estado de Durango, supply exfoliated bladder cells isolated from the urine of Mexican residents exposed to arsenic in drinking water.

Stýblo's innovative analytical methods will give epidemiologists cheaper and better ways to identify and understand how arsenic harms human beings. The goal, he says, is to transfer this methodology to the field. That will give those working to stop a killer a new weapon to use. ■

–Kathleen Kearns

Dr. Stýblo (center) poses with Dr. Luz María Del Razo (second from left), UNC's Dr. Zuzana Drobna (in orange), Mayor Eusebio Aguilar and local public health workers in Zimapan, Mexico.