

# Nonmetallic Toxic Chemical Assessment

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## INTRODUCTION

Nonmetal toxic chemicals cause diseases of virtually every organ in the human body and in virtually all animals, including fish, amphibians, reptiles, birds, and mammals. In addition, such chemicals may alter the microbiome in the soil and water and in the gastrointestinal tracts of animals. Such toxic chemicals come from multiple sources, including the air, water, food, pharmaceuticals, cosmetics, cleaning agents, and prescription and over-the-counter medications. Roughly 13,000 chemicals are used in cosmetics, of which only 10% have been properly evaluated for safety.

Doris Rapp, a physician and pioneer in the field of environmental medicine, reported that in 1998, more than 80,000 different chemicals with a total weight of 1.2 billion pounds were used in the United States.<sup>1</sup> With a population of about 300 million people at the time, that calculates to 4 pounds of chemicals for every person in the nation. Furthermore, less than 10% of the chemicals used have been even partially evaluated for safety, and in the majority of those evaluated, there was no assessment of safety for women and children. Dr. Rapp's books *Is This Your Child's World?*<sup>2</sup> and *Our Toxic World*<sup>1</sup> are excellent, comprehensive works on the clinical effects of both metal and nonmetal toxic chemicals.

Furthermore, the vast majority of people today are not exposed to a single chemical but to a wide variety of chemicals. In such cases, the cumulative effects of multiple chemical exposures over long periods of time are much greater than just the additive effects of such chemicals. The Environmental Working Group's study commissioned five laboratories to examine the umbilical cord blood of 10 babies of African American, Hispanic, and Asian heritage and found more than 200 chemicals in each newborn.<sup>3</sup>

Results from the widest-ranging European survey of human toxic contamination show that 76 persistent, bioaccumulative, and toxic industrial chemicals were present in the blood of those tested.<sup>4</sup> The World Wildlife Fund (WWF) and the Co-operative Bank collected and analyzed the blood of 47 people from all over Europe. These included 39 Members of the European Parliament (MEPs),<sup>4</sup> observers from accession countries, 1 former MEP, and 3 WWF staff, representing 17 countries in Europe.<sup>4</sup> Blood samples were analyzed for an unprecedented 101 chemicals from five groups: organochlorine pesticides such as dichlorodiphenyltrichloroethane (DDT), polychlorinated biphenyls (PCBs), brominated flame retardants, phthalates, and perfluorinated

compounds (PFCs). A total of 76 different chemicals from the 101 looked for were found in the blood of those tested.

The highest number of chemicals found in one person was 54, and the median number of chemicals detected was 41. At least 13 of the same chemicals were found in every single person tested, including chemicals banned in Europe over 20 years ago as well as chemicals in widespread use today, such as phthalates and PFCs. This huge toxic burden is more fully covered in [Chapter 35](#), Environmental Medicine, and comprehensively in *Clinical Environmental Medicine* (Crinnion and Pizzorno, Elsevier, 2018).

## NONMETALLIC TOXIC CHEMICALS, METALLIC TOXIC CHEMICALS, AND TOXIC METALS

The reason for differentiating metal and nonmetal toxic chemicals is that these two groups are analyzed in blood and urine by different technologies. The toxic metals were primarily tested first by atomic absorption and later by induction-coupled plasma mass spectrometry (ICP-MS). The nonmetal toxic chemicals have been tested effectively with gas chromatography, followed by gas chromatography combined with mass spectrometry (GC/MS), and then with liquid chromatography combined with mass spectrometry (LC/MS). The main advantage of ICP-MS for toxic metals is that a large number of metals (50 or more) can be tested simultaneously on a single sample, such as blood, urine, stool, or hair, without the use of chromatography. Testing of nonmetal toxic chemicals typically requires much more complex sample extraction and almost always complex chromatography. These differences in the analytical testing of metal and nonmetal toxic chemicals have made the testing of metal toxic chemicals faster and cheaper than the testing of nonmetal toxic chemicals, resulting in much greater research and knowledge regarding metal toxic chemicals compared with nonmetal toxic chemicals. The ease of analytical testing has also led to much more regulation on contamination with toxic metals compared with nonmetal toxic chemicals.

Until very recently, screening tests for a wide variety of toxic chemicals were only available by the clinician ordering a few tests at a time from large reference laboratories. Because most individuals had no idea what chemicals they were exposed to, it was prohibitively expensive to order a large number of chemical tests. Recently, however, tests for a large variety of toxic chemicals have become available.