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Two years ago, in 1997, the International Agency for Research on Cancer (IARC) formally concluded that dioxin causes cancer in humans.[1] IARC is a division of the World Health Organization (WHO) and its recommendations carry considerable weight in the world of public health policy.

Dioxin is the name of a family of 219 toxic chemicals, many of them created as unwanted byproducts of numerous industrial processes: incineration of municipal solid waste, hazardous waste and medical waste; the smelting of metals; the manufacture of chlorine-bleached paper; and the production of many pesticides and other toxic chemicals. Basically, any time you have high temperatures and the presence of chlorine-containing chemicals, you have conditions that can spawn dioxins.

Over the years, many studies of laboratory animals have shown that dioxins can cause many different kinds of cancer. However, in reaching its 1997 conclusion, IARC relied on studies of humans, specifically, four studies of workers exposed to high levels of dioxin on the job. The four studies revealed a remarkably consistent effect from dioxin exposure: a 40% increased chance of dying from cancer. In all four studies, the effect was highly statistically significant.[2]

In three of the four studies, data for estimating dioxin exposures was available in 1997. Using the available exposure data, the authors of the three studies were able to observe a clear "dose response relationship" -- as the level of dioxin exposure increased, so did the chances of dying of cancer. Seeing a "dose response relationship" gives researchers more confidence that the relationship they have observed (in this case, between dioxin exposure and cancer) is real.

Now information about dioxin exposures among the fourth group of workers has become available, and a dose-response relationship can be seen in those workers as well.[3] The more dioxin they were exposed to on the job, the greater their chances of dying of cancer.

This fourth group was the largest of them all -- 5132 workers at 12 U.S. industrial plants where they were exposed to dioxin over many years. Researchers at the U.S. National Institute for Occupational Safety and Health (NIOSH) were able to find job histories for 69% of the 5132 workers and thus could categorize them into seven groups according to their dioxin exposures.

The new information appears in the May 5 issue of the JOURNAL OF THE NATIONAL CANCER INSTITUTE. In their report, the NIOSH researchers explain that they saw a 13% increased chance of dying of cancer among the 5132 workers, compared to an unexposed group. Among the highest two exposure groups, they observed a 60% increased chance of dying of cancer.

In sum, we now have four separate studies of groups of humans who have been exposed to dioxin and who are dying disproportionately from cancers. These studies provide support for many previous studies of laboratory animals showing that dioxin causes various cancers.

Does this close the book on dioxin and cancer? Unfortunately, it does not.

Every group of humans who have been exposed to high levels of dioxins has now been studied. There aren't any other groups to study. Therefore, the data that are available now are probably the only human data we will ever have. (Of course as time passes these same groups will be studied further, but the results are not likely to change dramatically.)

With today's data, it is still possible to reach conclusions that are 180 degrees out of synch with each other. In an editorial in the JOURNAL OF THE NATIONAL CANCER INSTITUTE May 5, Dr. Robert N. Hoover of the U.S. National Cancer Institute wrote, "My belief, based on the current weight of the evidence, is that TCDD [the most potent dioxin] should be considered a human carcinogen."[2] This is precisely what the World Health Organization concluded two years ago.

In contrast, when the British medical journal LANCET ran a news story reporting the latest dioxin findings from the JOURNAL OF THE NATIONAL CANCER INSTITUTE, they quoted Michael Kamrin, a toxicologist from Michigan State University (East Lansing, Mich. USA) who said the dioxin data is "unconvincing and epidemiologically weak... These data don't suggest to me that there's any health risk from dioxin [TCDD]. I didn't think so before, and I don't think so now," Kamrin told the LANCET.[4]

So the question is, how should ordinary people react to dioxin? When we learn that we and our children are breathing dioxins created by a medical waste incinerator, or a garbage incinerator, or a cement kiln burning hazardous waste, what should we think? Should we accept the opinion of Robert Hoover from the National Cancer Institute that dioxin is probably a cause of human cancers? Or should we accept the words of Michael Kamrin at Michigan State who says there isn't any health risk from dioxin? Experts can always disagree, but citizens must make choices in the best interests of themselves and their families.

It seems clear that science cannot solve this kind of dilemma. There has never been a chemical studied more thoroughly than dioxin. For the past decade the U.S. government has been conducting a detailed analysis of many hundreds of previous studies of the health effects of dioxins (in animals and humans). Furthermore, the government has spent millions of dollars conducting new studies of dioxin's effects on humans (for example, the NIOSH study, discussed above) and animals. In addition, the Chemical Manufacturers Association and the Chlorine Chemistry Council have spent substantial sums of money hiring their own brand of scientist to try to tilt the balance in the direction of "dioxin is no problem." (As you might imagine, there are huge sums of money riding on the outcome of the dioxin debate.)

For most chemicals, we can probably never expect to get data as good as the data we have now for dioxin. Given limited funds for study, and given that there are 70,000 chemicals now in use and 1000 new ones added each year, we cannot realistically expect anything like "thorough" data on the health effects of any particular toxic chemical.

Therefore, how should we, the public, react to dioxin or any other toxic chemical? There are two basic ways of approaching such a question -- risk assessment or precaution.

Risk assessment asks the question, How much damage are we willing to tolerate from dioxin exposure? Risk assessors usually answer this question by saying that it is "acceptable" to kill one in every million people exposed to dioxin. (Sometimes they give a different answer, saying it is OK to kill as many as one in every 10,000 people exposed to chemical A or chemical B, but usually their answer is that one-in-a-million is the acceptable kill ratio.)

Now let us remove our rose-colored glasses for just a moment and be blunt. You rarely find a risk assessor who will say so, but the one-in-a-million formula is, at base, a prescription for legalized murder. The dead person is selected at random and is killed anonymously. But it is still a premeditated, planned death. If "risk assessment science" improved to the point where the victim's identity were known, then everyone would agree that a murder had been committed.

Once the community of risk assessors has accepted that it is OK to kill one-in-a-million citizens by exposing them to dioxin (or some other toxicant du jour), then the mathematicians and toxicologists go to work and develop a formula that says "exactly this much dioxin can be emitted into the community, and no more, if we are to

abide by the one-in-a-million limit of 'acceptable risk.'" Then it is up to the engineers to design a machine that will emit just the "acceptable" amount of dioxin or other toxicant and no more. And then the government regulators ratify and enforce the engineer's limit. That is the sum and substance of the "risk assessment" approach to controlling toxic exposures, from dioxin or from any other deadly agent.

A different way to view the problem is to ask, How can we avoid dioxin exposures and so avoid the possibility of killing people with dioxin? This is the approach embodied in the "principle of precautionary action." The precautionary principle says,

"When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically. In this context the proponent of an activity, rather than the public, should bear the burden of proof. [See REHW #586.]

"The process of applying the Precautionary Principle must be open, informed and democratic and must include potentially affected parties. It must also involve an examination of a full range of alternatives, including no action."

A precautionary approach to dioxin would look at the available (sometimes conflicting) evidence about dioxin and ask, "If we think it is better to be safe than sorry, shouldn't we avoid dioxin exposures when we can?" And then the search would begin for alternative ways to avoid dioxin exposures. Shutting down incinerators -- or, better yet, not ever building incinerators -- would be one feasible approach. There are numerous alternatives to incineration, and a "better safe than sorry" strategy would examine all of them.

Reducing our use of chlorine-containing chemicals would be a second approach. There are few, if any, uses of chlorinated chemicals that are essential and irreplaceable. Alternatives are available.

In sum, a precautionary approach would not ask "How many dioxin deaths can we tolerate in our society?" -- instead, it would ask, "How can our society avoid making dioxin?"

The risk assessment approach, which has been the "official" approach in the U.S. for the past 25 years, excludes citizens for the most part because they don't have the knowledge to calculate the one-in-a-million kill ratio. Only the "risk experts" are able to do that. In that sense, the risk assessment approach is undemocratic and even anti-democratic. \tab But when it comes time to deciding whether an incinerator is the best way to handle the community's garbage, people can get involved. They can ask citizens in other communities how they are handling THEIR garbage. They can sponsor public discussions in which various groups (including waste companies) send representatives to tell how they would handle the community's wastes. People can ask about the sources of waste in their community and they can demand a "clean production" approach to those sources. (See REHW #650, #651.) Then people can discuss the pros and cons of what they have heard and can make up their own minds about what's best. Unlike risk assessment, the precautionary approach fosters citizen participation and promotes democracy.

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[1] Douglas B. McGregor and others, "An IARC Evaluation of Polychlorinated Dibenzo-P-dioxins and Polychlorinated Dibenzofurans as Risk Factors in Human Carcinogenesis," ENVIRONMENTAL HEALTH PERSPECTIVES Vol. 106, Supplement 2 (April 1998), pgs. 755-760.

[2] Robert N. Hoover, "Dioxin Dilemmas," JOURNAL OF THE NATIONAL CANCER INSTITUTE Vol. 91, No. 9 (May 5, 1999), pgs. 745-746.

[3] Kyle Steenland and others, "Cancer, Heart Disease, and Diabetes in Workers Exposed to 2,3,7,8-Tetrachlorodibenzo-p-dioxin," JOURNAL OF THE NATIONAL CANCER INSTITUTE Vol. 91, No. 9 (May 5, 1999), pgs. 779-786.

[4] Marilynn Larkin, "Public-health message about dioxin remains unclear," LANCET Vol. 353 (May 15, 1999), pg. 1681.

Descriptor terms: iarc; who; dioxin; carcinogens; risk assessment; precautionary principle; clean production; alternatives assessment;