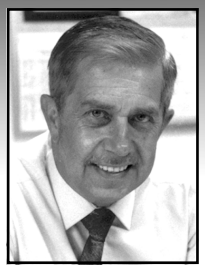

Fact or Fiction?

Jack W. Dini, AESF Fellow • 1537 DeSoto Way
Livermore, CA 94550 • E-mail: jdini@earthlink.net

One in a Million

Here are some activities that increase our chance of death by one in a million:[1]

- Smoking 1.4 cigarettes
- Traveling 10 miles by bicycle
- Traveling 300 miles by car
- Traveling 1000 miles by commercial aircraft[2]

They all seem pretty trivial, don't they? These, along with other activities that increase the chance of death by one in a million are listed in the table. One in a million (10^{-6}) is also used to assess human health risks. Lifetime exposure to a substance associated with a risk of 10^{-6} would increase our current chances of developing cancer which is about 1 in 3, by 0.0003 percent.[3] Stated another way, the regulatory agencies are attempting to reduce the cancer incidence of 300,000 people to 299,999. Problems arise with assigning a specific figure to the number of cases of cancer considered acceptable. It gives the public the false impression that the figure is a matter of scientific fact rather than a statistically derived estimate. As Ottoboni[4] points out, "It delivers the erroneous message that one in a million people, no more, no less, will actually develop cancer from exposure to the chemical in question. It misleads the public into believing that one extra case of cancer in a population of a million people actually could be measured and the cause could be identified. Finally, it frightens some people who fear that they or one of their loved ones may become that one unfortunate soul in a million."

The past, present and future costs of complying with this stringent criterion are virtually incalculable.[3, 5] It is difficult to imagine a criterion in wider use in the U.S. Some examples where it is used include:[3]

- Pesticides in food additives
- Allowable exposure to groundwater contamination and incinerators
- Emissions from stacks
- How a hazardous waste site should be cleaned up
- How much alar to leave on apples

Because of the many billions of dollars spent in attempting to achieve this goal for cleanups of hazardous waste sites in the U.S., one might be tempted to ask the question: What are the origins of 10^{-6}? The answer is that there is no sound scientific, social, economic or other basis for the selection of 10^{-6} as a cleanup goal for hazardous waste sites. Extensive research by Kelly and Cardon[3] led them to state: "Remarkably, the criterion, which has cost society billions of dollars, has never received widespread debate or even thorough

Risks that Increase Chance of Death by One in a Million*

Activity	Cause of Death
Smoking 1.4 cigarettes	Cancer, heart disease
Fireworks	Accident **
Drinking 1/2 liter of wine	Cirrhosis of the liver
Living 2 days in New York or Boston	Air pollution
Living 2 months in Denver on vacation from New York	Cancer caused by cosmic radiation
Living 2 months in average stone or natural brick building	Cancer caused by radioactivity
Traveling 6 minutes by canoe	Accident
Traveling 10 miles by bicycle	Accident
Traveling 300 miles by car	Accident
Traveling 1000 miles by commercial aircraft	Accident ***
One chest X-ray	Cancer
Eating 40 tablespoons of peanut butter	Liver cancer caused by aflatoxin B
Eating 100 charcoal-broiled steaks	Cancer from benzpyrene

** Wilson, ref. 1.*
*** Chapman and Morrison, ref. 7.*
**** Popescu, ref. 2.*

regulatory or scientific review. It is an arbitrary level proposed 35 years ago for completely different regulations (animal drug residues), the circumstances of which do not apply to hazardous waste site regulation. As a result, implementing it has frequently been socially, politically, technically and economically infeasible."

The review conducted by Kelly and Cardon included an informal telephone survey of affected agencies and an extensive literature search. They found that none of the officials contacted at any Federal or state agency using 10^{-6} as a criterion knew the basis of this criterion, nor was there any readily available documentation that specifically described the origin of 10^{-6}. They discovered that the concept of 10^{-6} was originally an arbitrary number finalized by the U.S. Food and Drug Administration as a screening level of "essentially zero" or *deminimis* risk. This concept was traced back to a 1961 proposal by two scientists from the National Cancer Institute regarding methods to determine "safety" levels in carcinogenicity testing.

How Is 10^{-6} Used?

Interestingly, the risk level of 10^{-6} is not consistently applied to all environmental legislation. Instead, it seems to be applied according to the general perception of the risk associated with the source being regulated. Hazardous waste sites, pesticides, and selected carcinogens have seen almost exclusive application of 10^{-6}, while air, drinking water or other sources perceived to be of less risk have not been subject to this requirement.[3] Cleanup levels for a given contaminant are not consistent from site to site and vary by orders of magnitude. Furthermore, in some cases there are extreme differences even among divisions of the same agency for the same substance. A case in point is arsenic, where there are six orders of magnitude (one-million fold) difference in target risk within different EPA regulations.[6]

Other Events

There is a one-in-a-million chance that an asteroid with a diameter of 10^4 meter (Mt. Everest size) will hit the Earth. If it did, the fatalities would range from 10^7 to more than 10^9 people. So, here's another one-in-a-million item to consider. As Chapman and Morrison[7] have stated, a typical U.S. citizen's death from a killer rock from space is much higher than the widely publicized threats from certain carcinogens and poisoning by commercial foods.

If you are a woman, the chances of being killed at work by someone you know are one in 600,000. Walsh[8] notes that if you consider this statistic another way, the EPA—with its one-in-a-million odds threshold for acceptable risk—would ban women from the workplace if it could.

Here's what Carl Sagan reports: "The odds of a miraculous cure at Lourdes are about one in a million. You are roughly as likely to recover after visiting Lourdes as you are to win the lottery, or to die in the crash of a regularly scheduled airplane flight—including the one taking you to Lourdes."[9]

Last, from Dean Edell: "What is one in one million? A disease that occurs that frequently will produce 270 cases in the American population. Three of them on a talk show will make you think it's an epidemic."[10]

P&SF

References

1. R. Wilson, *Technology Review*, **81**, 41 (Feb. 1979).
2. C.B. Popescu, "Risk Assessment," *Issues in the Environment,* American Council on Science and Health (June 1992).
3. K.A. Kelly & N.C. Cardon, *EPA Watch*, Vol. 3, No. 17, 4 (Sept. 15, 1994).
4. M.A. Ottoboni, *The Dose Makes the Poison*, Second ed., Van Nostrand Reinhold (1997).
5. B. Yandle, "Human Health and Costly Risk Reduction," *The Freeman*, Vol. 45, No. 3, 174 (March 1995).
6. C.C. Travis, *et al., Environ. Sci. Technol.*, **21**, 415 (1987).
7. C.R. Chapman & D. Morrison, *Nature*, **367**, 33 (Jan 6, 1994).
8. J. Walsh, *True Odds: How Risk Affects Your Everyday Life*, Merritt Publishing (1996).
9. C. Sagan, *The Demon Haunted World*, Random House (1995).
10. D. Edell & D. Schrieberg, *Eat, Drink & Be Merry*, HarperCollins Publishers (1999).

Questions or comments for P&SF columnists? E-mail them to editor@aesf.org

❖❖❖

Need information on products or services advertised in this issue? Just use the postpaid reader service card or visit www.aesf.org/psf-qwiklynx.htm