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What does one-in-a-million risk really mean?

Very literally, one-in-a-million means that there is one chance in a million that something will happen. To put this in context, one-in-a-million is equivalent to a single step in a journey of 568 miles or one minute in two years. So one-in-a-million is a very small probability.

Of course, the way EPA uses the concept is much more complicated. The Agency defines a 1-in-a-million ($1x10^{-6}$) cancer risk as follows (http://www.epa.gov/airtoxics/natamain/gloss1.html).

> A risk level of 1 in a million implies a likelihood that up to one person, out of one million equally exposed people would contract cancer if exposed continuously (24 hours per day) to the specific concentration over 70 years (an assumed lifetime). This risk would be an excess cancer risk that is in addition to any cancer risk borne by a person not exposed to these air toxics. Note that this assessment looks at lifetime cancer risks, which should not be confused with or compared to annual cancer risk estimates. If you would like to compare an annual cancer risk estimate with the results in this assessment, you would need to multiply that annual estimate by a factor of 70 or alternatively divide the lifetime risk by a factor of 70.

What does this definition mean in real world terms? There are two components of this definition that need to be considered:

- The definition included the term "equally exposed" which means that it is a measure of the likelihood that at least one person out of a million equally exposed individuals would contract cancer; and
- The individual is exposed to that risk continuously for 70 years (24 hours a day, 365 days a year for 70 years).

To put this into perspective, the American Cancer Society (http://www.cancer.org/cancer/cancerbasics/lifetime-probability-of-developing-or-dying-from-cancer accessed on July 29, 2015) estimates that the lifetime risk for a male to develop some type of cancer in their lifetime is 43.31%. Said differently, 433,100 out of 1,000,000 males will develop some form of cancer in their

lifetime. If exposed to a one-in-a-million risk for cancer under EPA's definition, instead of 433,100 males getting cancer, 433,101 males would – an increase of one person. This would change the percentage risk from 43.31% to 43.3101%, a minimal increase for an individual. In many ways, this is a nonsensical calculation considering the inherent uncertainty in risk assessment calculations, fate and transport assumptions, and population surveys but it does point out the fact that an exposure to a one-in-a-million risk for developing cancer really does not change the overall chances of developing cancer. Even if the risks were 100-in-a-million, it would only increase the overall risk from 43.31% to 43.32%.