How Safe is Safe: Examining the Past and Present to Gain a Perspective on the Future

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How Safe is Safe?
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• Chance of any person being hit by a meteor – 1 in 3,200
• Chance of YOU being hit by a meteor – 1 in 20 trillion
• Lifetime risk of developing cancer – 1 in 2 for males, 1 in 3 for females\(^1\)
• Lifetime risk of dying from cancer – 1 in 4 for males, 1 in 5 for females\(^1\)

\(^1\)US National Cancer Institute’s Surveillance Epidemiology and End Results (SEER) Database
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• The FDA looks at risks in different ways according to its authority to regulate:
  – With food additives, safety is assessed at a specified exposure
  – With contaminants, risk is quantified whenever a hazard is known to exist

• One problem lies in defining the risk to humans for a hazard that has not been studied directly in humans at the typical exposure level
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The Past:

- Historically, the risk of exposure to chemical and microbial hazards has been evaluated based on actual data from human exposure, acute and chronic studies with laboratory animals and \textit{in vitro} models
  - Newly recognized chemical hazards rarely come with human data from exposure at typical levels
  - We are better off understanding some microbial risks, but have a large amount of uncertainty for some microbial hazards at low doses
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The Past:

• If the public really understood how risk is evaluated and acceptable limits of exposure are determined, I doubt they would be entirely comfortable with the result:
  – Data from lab animals are extrapolated to humans
  – Safety factors are included to address uncertainty at all levels
  – Generally, we tolerate serious risks that fall in the range of < 1 in 1 million to < 1 in 100,000 lifetime risk
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The Future:

• The use of animals models is in decline:
  – Animal welfare concerns
  – Animal results can be misleading
  – Costly

• To fill the gap from the loss of animal studies:
  – Better use of epidemiological data when available
  – Use of *in vitro* hazard screening to identify potential hazards for further *in vivo* testing
  – Developing definitive *in vitro* tests
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The Future:

• Risk Modeling and *in vitro* testing:
  – Quantitative Structure Activity Relationship (QSAR) – promising, but not yet the answer
  – Human cell culture toxicity tests – ex., hepatocyte and myocardiocyte models
  – Invertebrate models
  – “Organ on a chip” models that integrate organ functions

• Benefits vs. risks