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

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How Safe is Safe?

How Safe is Safe?

- 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 *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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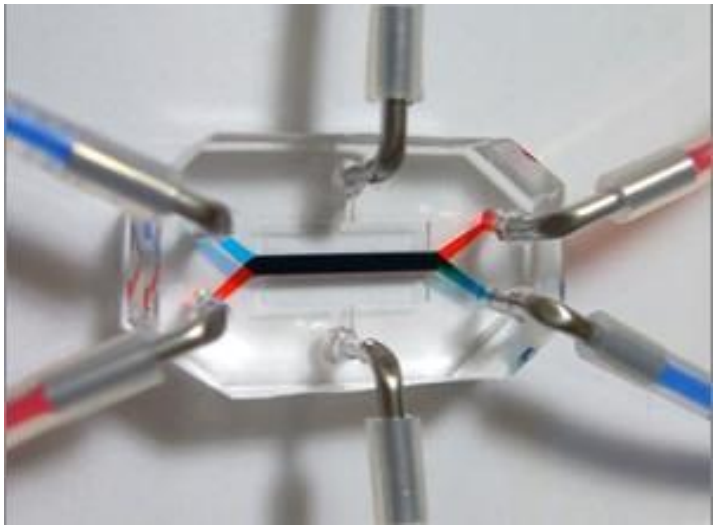
The Future:

- 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



Gut on a chip from the Wyss Institute