

# Total Diet Studies: Protecting the Public from Chemical Hazards in Food

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Der Mensch ist was er ißt.

Ludwig Feuerbach, 1863



# Digging our graves with our teeth



# Are Chemicals in Food Safe?







# Paracelsus



# Father of Toxicology

**All substances are poisonous;  
there is none that is not a poison;  
the dose differentiates a poison  
from a remedy.**

Paracelsus 1540



# 'Silent Spring' Is Now Noisy Summer

## Pesticides Industry Up in Arms Over a New Book

By JOHN M. LEE

The \$200,000,000 pesticides industry has been highly irritated by a quiet woman's rather abrupt previous work on science and has praised for the beauty and tone of the writing.

The author is Rachel Carson, whose "The Sea Around Us" and "The Edge of the Sea" have won her a reputation as a writer. Her new book, "Silent Spring," is now being published by Houghton Mifflin Co.



## Rachel Carson Stirs Conflict—Producers Are Crying 'Foul'

Protesting the use of their products. Hearings have been held in Washington and New York. Statements are being drafted and counter-attacks planned.

A dramatic indictment has already been prepared by the greatest speaker in the persuasive industry. The book is expected to be published in the summer of 1962.

More than 100,000 copies of the book have already been sold.

# Low-Level Chemicals in Food

- Cannot be detected by sight, taste or smell
- Cannot generally be destroyed or removed
- Illness appears slowly over months, years or even decades.

# Health Affects Linked to Chemicals

- Cancer
- Kidney and liver disease
- Hormonal imbalance
- Immune system suppression
- Musculoskeletal diseases
- Birth defects
- Premature births
- Impeded nervous development
- Reproductive disorders
- Mental health problems
- Cardiovascular diseases
- Genitourinary diseases
- Old-age dementia
- Learning disabilities
- Obesity?
- Diabetes?

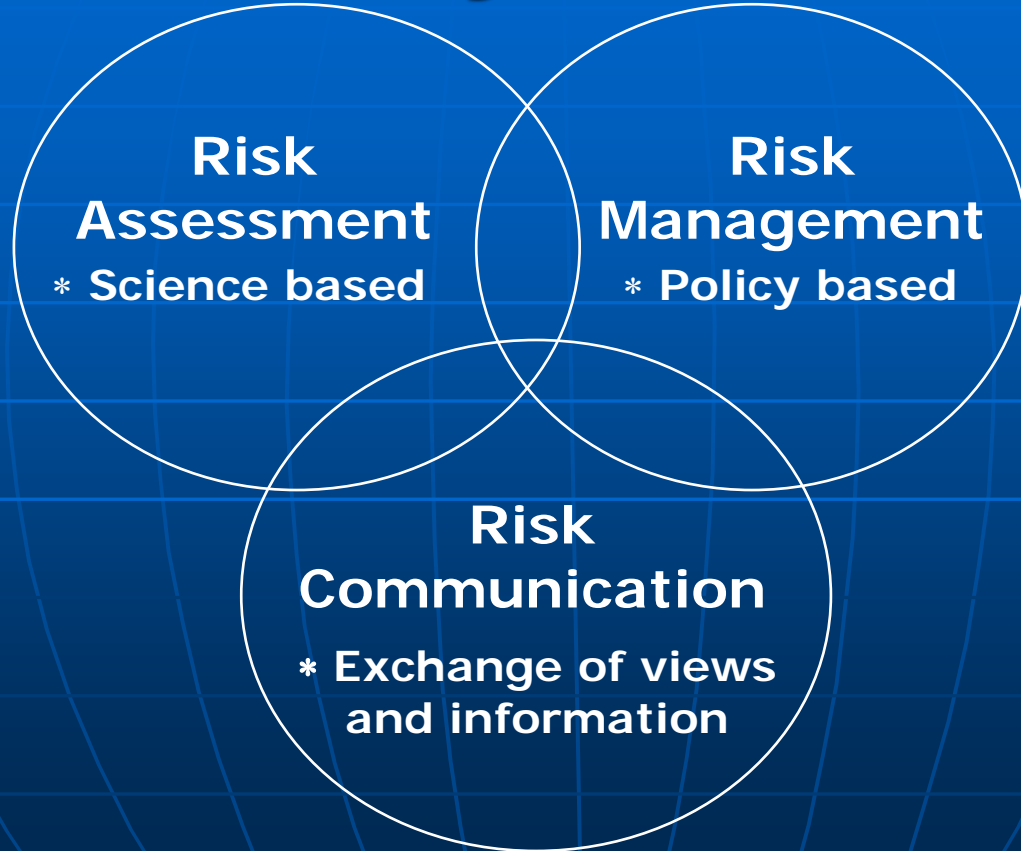
# Chemicals in food may have destroyed civilizations



# Hazard is not Risk!

- An agent with the potential to cause harm
- Likelihood and severity of an adverse event.

# Risk Analysis Paradigm





# Risk Assessment Process



# Hazard Identification

The agent and the associated  
adverse health effect

Lead - neurotoxicity and hypertension

Dioxins – endocrine disruption

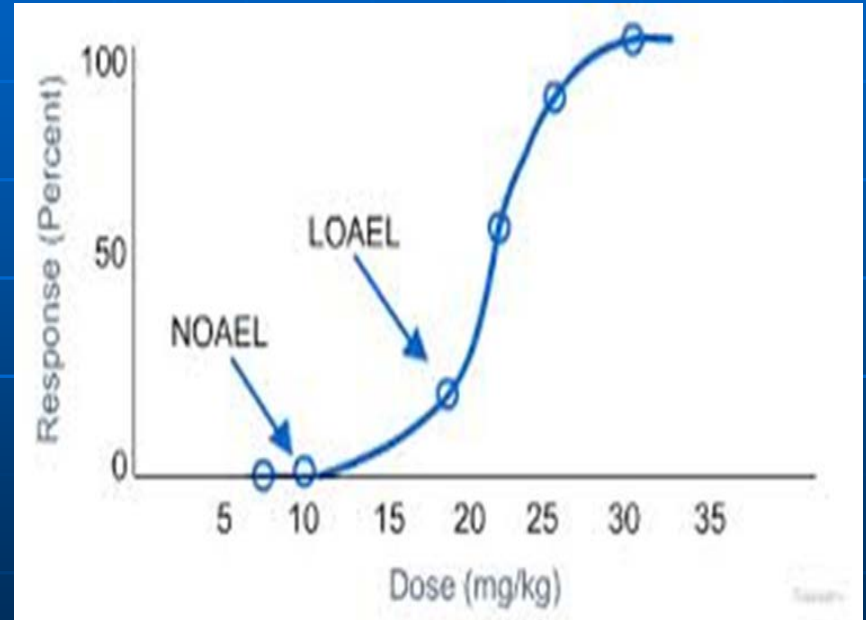
Cadmium – kidney injury

# Priority Chemicals

- Food additives
- Pesticide residues
- Heavy metals
- Industrial pollutants
- Naturally occurring toxicants
- Processing/packaging contaminants
- Essential nutrients

# Hazard Characterization

- Acceptable Daily Intake
- Provisional Tolerable Intake
- Margin of Exposure
- Recommended Dietary Intake
- Maximum Daily Intake



# Exposure Assessment

$$\text{Dietary Exposure} = C \times F$$

C = Concentration of chemical in the food

F = Amount of the food consumed

# Multi-Food Exposures

$$\text{Dietary Exposure} = \sum C_i \times F_i$$

$$= C_a \times F_a + C_b \times F_b + C_c \times F_c + C_d \times F_d + \dots\dots\dots$$

$C_i$  = Concentration of chemical in food i

$F_i$  = Amount of food i consumed

















Every country has its own  
dietary pattern and  
methods of food  
preparation

# Individual Consumption Survey

- 24 hour recall on 2 non-consecutive days
- Supplemented by food frequency
- At least 5,000 respondents
- All cohorts by age and sex



# Methylmercury in Fish

Amount of fish consumed = 100 g/week

Concentration of chemical = 2 mg/1000 g

Exposure =  $\frac{100 \text{ g/week} \times 2 \text{ mg/1000 g}}{1000} = .2 \text{ mg/week}$

Expressed on body weight = .0040 mg/week/kg bw for  
50 kg person

Compare with PTWI of .0016 mg/week/kg bw

# Multi-Food Exposures

$$\text{Dietary Exposure} = \sum C_i \times F_i$$

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$C_i$  = Concentration of chemical in food i

$F_i$  = Amount of food i consumed

# Levels of Chemicals in Food

How to assess low levels of multiple chemicals in multiple food?

## Total Diet Studies



# Steps in a Total Diet Study

- Conduct survey on the amounts of food consumed by individuals in each cohort, including food preparation details
- Collect and prepare foods as typically consumed
- Measure chemical of interest in those prepared foods
- Estimate dietary exposure to a chemical
- Compares exposure estimates with the health-based guidance level

# Advantages of Total Diet Studies

- Foods are analyzed "as consumed" providing the best estimate of actual dietary exposure
- Assesses mean and high percentile exposures for age/sex cohorts and other groups of interest
- A large number of chemicals can be evaluated in one study
- Most cost-effective method for obtaining dietary exposure information



# Advantages of Total Diet Studies

- Provides a scientific basis for justifying and establishing maximum limits as required by international agreements
- Provides a tool for assessing the effectiveness of intervention measures
- Simple and easy to understand for managers and consumers
- Periodic studies can provide baseline information on the levels and trends of chemicals in the food supply.

# Countries with Total Diet Studies

Australia, Belgium, Cameroon, Canada, Chile, China, Czech Republic, Columbia, Croatia, Denmark, Egypt, Estonia, Finland, France, Fiji, Germany, Guatemala, India, Indonesia, Ireland, Italy, Japan, Republic of Korea, Kuwait, Latvia, Lebanon, Malaysia, the Netherlands, New Zealand, Norway, Panama, Papua New Guinea, Poland, Portugal, Slovak Republic, Spain (National, Basque Country and Catalonia), Sweden, Switzerland, Taiwan (China), Tunisia, Turkey, United Kingdom and United States of America

And soon, many others

# Protecting Our Future



# Improving Our Future



**Thank You For Your Attention**

**Danke für Ihre Aufmerksamkeit**