

# Global Burden of Disease Associated with Ionizing Radiation

Radiation and Environmental Health Program  
Department of Protection of the Human Environment  
World Health Organization



# What is Environmental Burden of Disease?

EBD is the **quantification** of health impacts caused by various environmental risk factors at **population level**, using a comparable and internally consistent framework, definitions and outcome measures

EBD estimated for all world regions for a certain risk factors is **Global Burden of Disease**



# WHO's GBD 2000 Project

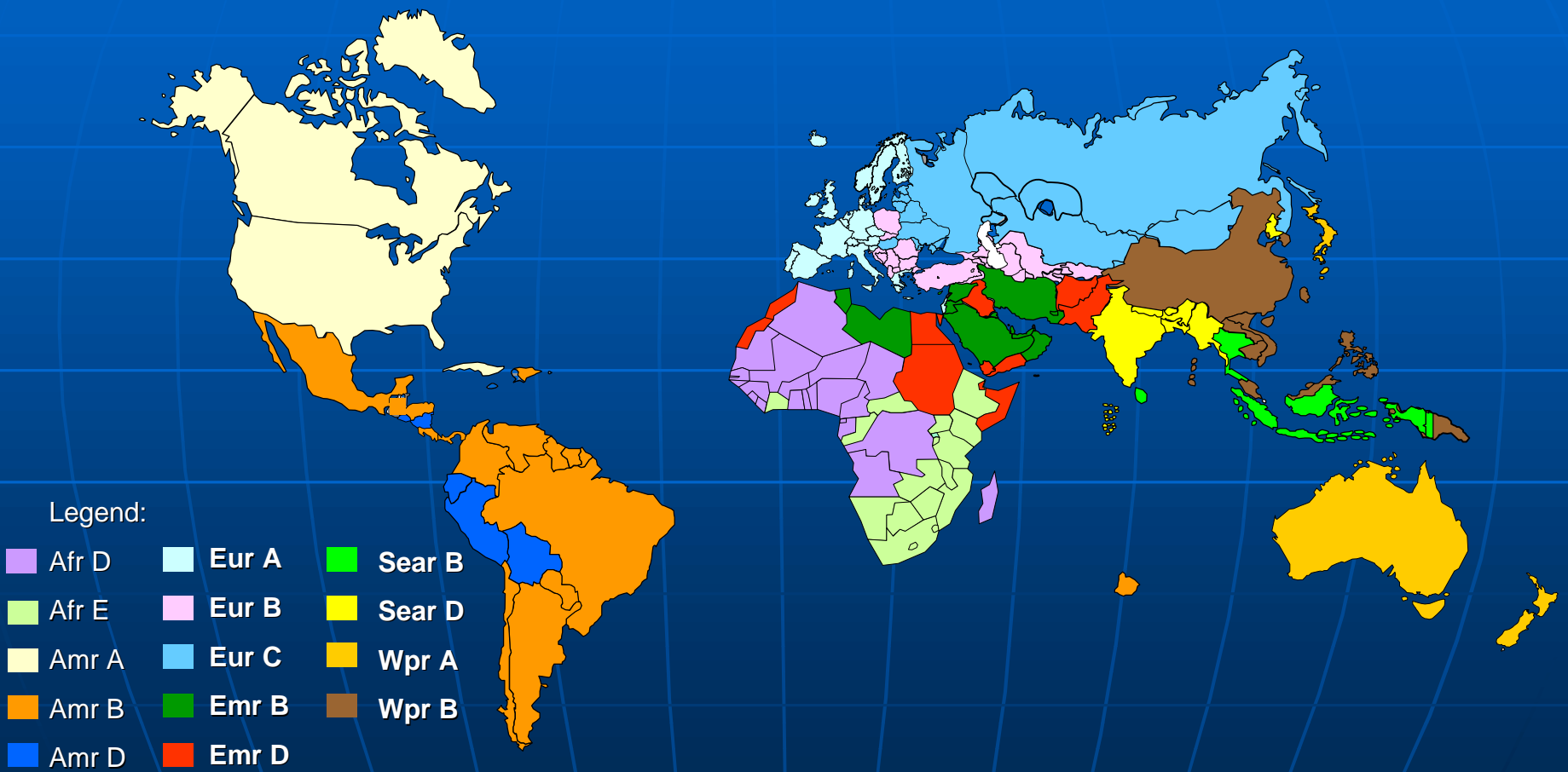
Three major goals:

- To decouple epidemiological assessment of the magnitude of health problems from stakeholders advocacy of particular health policies and interventions
- To include into international health policy consideration of non-fatal health outcomes along with information on mortality
- To undertake the quantification of health problems in time-based units that can also be used in economic appraisal of cost-effectiveness of interventions and resource distribution



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# World Regions Serving as Calculation Basis for GBD Assessment



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# What Do We Want to Achieve?

- Draw a global picture of health impacts from risks associated with environmental and man-made (+medical?) sources of ionizing radiation (IR)
- Assist countries in drawing more precise national picture of disease burden caused by IR
- Provide a tool for monitoring progress in environmental management
- Provide a tool for identifying intervention measures



# How do we achieve that?

## Burden of disease concept

- Quantify disease burden from IR exposure
  - Use **health summary measures** (disability, mortality)
  - Use same methodology for comparison between populations
- Quantify impact of interventions
  - Estimate health gains after specific interventions
  - Estimate health gains for different policy scenarios



# Health Summary Measures

- Combine information on mortality and morbidity to represent population health in one single indicator
- Indicators –Healthy life expectancy (HLE), Active life expectancy (ALE), Healthy life loss (unit - DALYs), etc.
  - Allow to compare different health outcomes
  - Compare health of several populations
  - Estimate health trends of one population



# Disability-Adjusted Life Years - DALY as a Unit for Healthy Life Loss

$$\text{DALY} = \text{YLL} + \text{YLD}$$

- *years of life lost because of premature death (YLLs)*
- *years of life lived with disability (YLDs)*

$$\text{Burden} = \text{Mortality} + \text{Disability}$$

- *One DALY = one lost year of healthy life*
  - *Death of a male at 50 = 30 DALYs*



# DALY = YLL + YLD

- $$YLL = \sum_{x=0}^L N_x (L - x)$$

*Where:*

*YLL = years lost due to premature mortality*

*N<sub>x</sub> = number of death at age x*

*L = standard life expectancy, years*

- $$YLD = \sum_i I_i \times DW \times l$$

*Where:*

*YLD = years lived with disability*

*I<sub>i</sub> = number of incidence cases of i condition*

*DW = disability weight (0-1)*

*l = duration of disability, years*



# Approaches to GBD Assessment

- Choice of indicators (UNSCEAR, 2000)
- Exposure Assessment (National? Regional?)
- Dose-Response Relationships, RR models
- Extrapolation to data-poor population groups
  - make reasonable assumptions
  - cannot always extrapolate
- DALY calculations by gender and age categories
- Peer review the results and reports

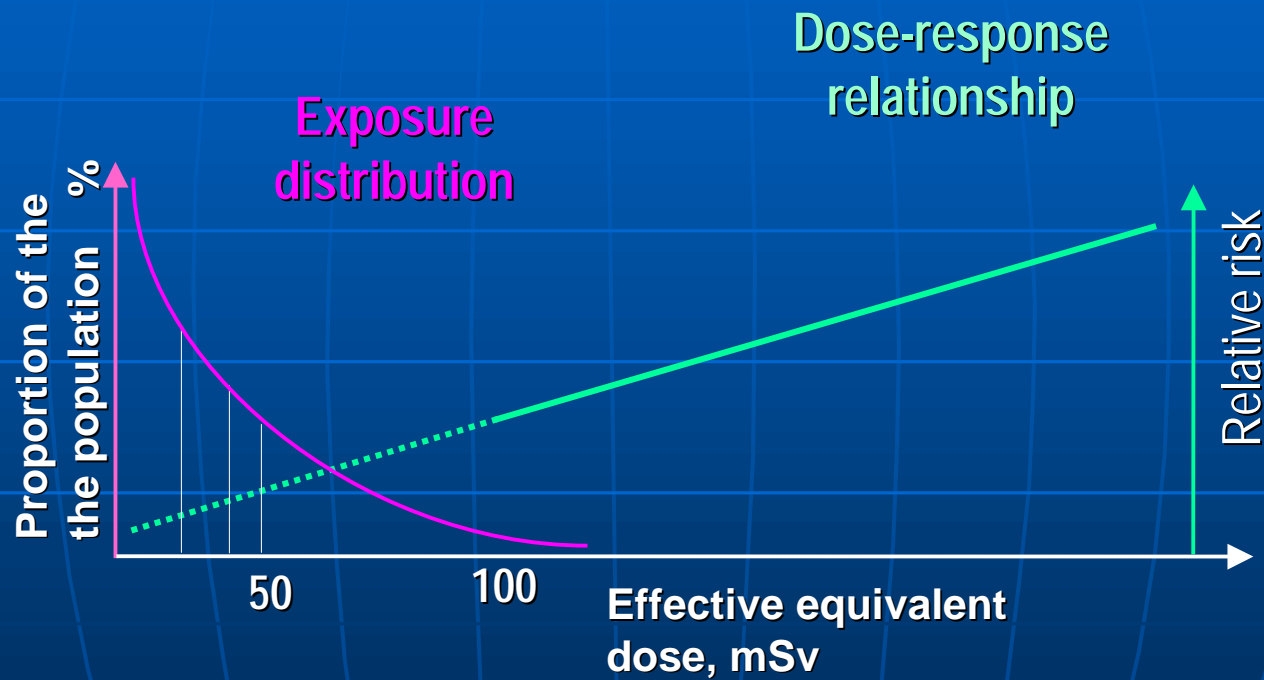


# Categorizing Risk Factors:

- By origin
  - Natural background radiation
  - Radioactive pollution
  - Medical applications
  - Occupational exposure
  
- By exposure way/radiation type
  - external (gamma, X-ray)
  - internal (beta, alpha)
  - combined
  
- By effect
  - lung cancer (Rn-222)
  - thyroid cancer (I-131)
  - other



# Method for GBD assessment



# Formula for Impact Fraction

$$IF = \frac{\sum (Pe_x \cdot RR_x) - 1}{\sum (Pe_x \cdot RR_x)}$$

Where:

$X$  = exposure level / dose

$Pe_x$  = prevalence of exposure at level  $x$

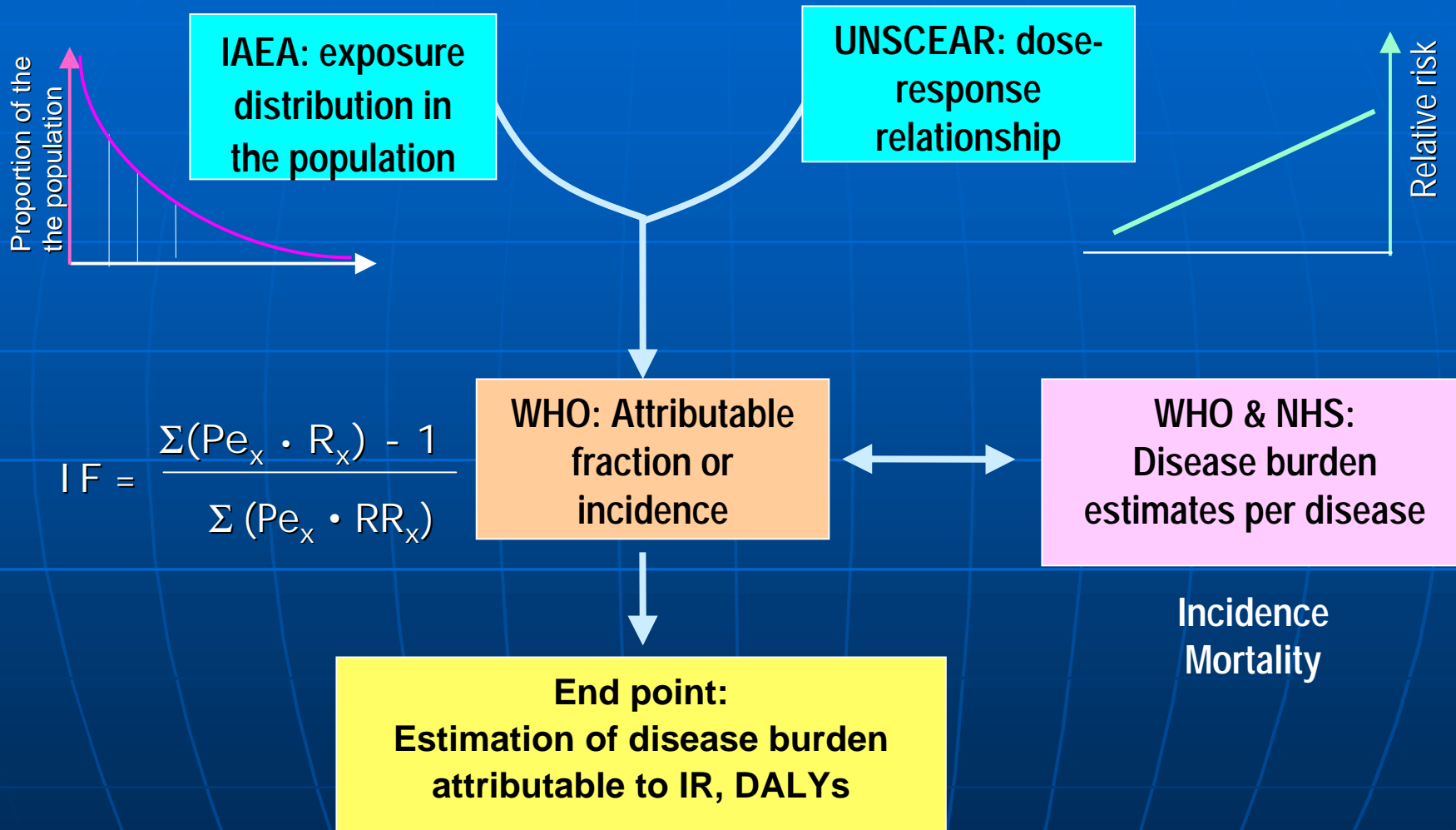
$RR_x$  = RR at exposure level  $x$

And finally:

Attributable burden = Disease burden x IF



# Exposure-based approach



# Summary

- Basic methodology is relatively simple
- Accuracy will depend on quality and quantity of data assessment
- Approximate (or preliminary) and more refined assessments are possible, depending on data input
- Assessment may be done at regional or national levels

