



*NORM IX, 9<sup>th</sup> International Symposium of Naturally Occurring Radioactive Material,  
Denver, Colorado, USA, 23 September 2019*

# Natural radioactivity: A public health perspective

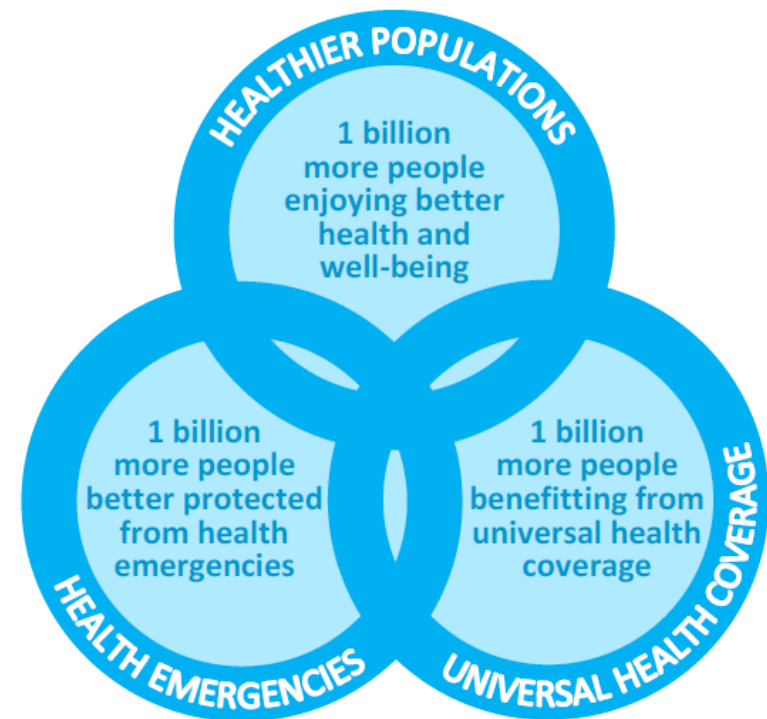
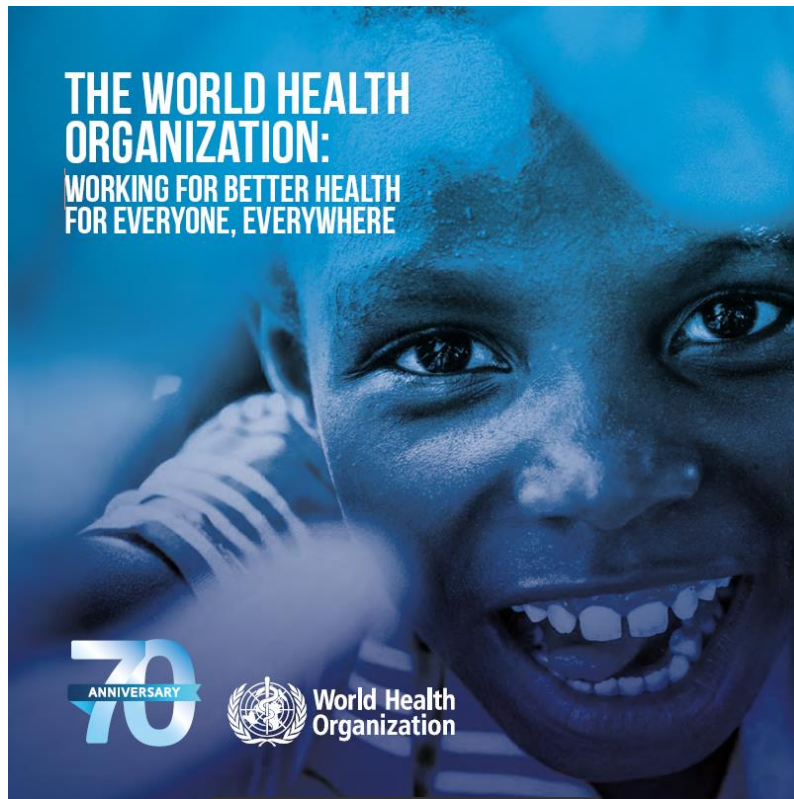
Dr Emilie van Deventer  
Radiation Programme

Department of Public Health, Environmental and Social Determinants of Health

# Content

- Introduction
- Existing exposure situations
- Inhalation of natural radioactivity: Radon
- Ingestion natural radioactivity: Drinking-water and food
- Discussion

# The World Health Organization



GPW13 (2019-2023)

## **HEALTH**

a state of complete physical,  
mental and social well-being  
and not merely the absence  
of disease or infirmity"

*(WHO Constitution, 1948)*

# WHO's core functions

1. **Articulating ethical and evidence-based policy positions**
2. **Setting norms and standards**, and promoting and monitoring their implementation
3. **Shaping the research agenda**, and stimulating the generation, translation and dissemination of valuable knowledge
4. **Providing technical support**, catalysing change and developing sustainable institutional capacity
5. **Monitoring the health situation and assessing health trends**
6. **Providing leadership** on matters critical to health and engaging in **partnerships** where joint action is needed

# The WHO 3-level structure



# HOW THE ENVIRONMENT IMPACTS OUR HEALTH

People are exposed to risk factors in their homes, work places and communities through:

**AIR POLLUTION**  
including indoors and outdoors



**INADEQUATE WATER, SANITATION and hygiene**



**CHEMICALS**  
and biological agents



**RADIATION**  
ultraviolet and ionizing



**COMMUNITY NOISE**



**OCCUPATIONAL RISKS**



**AGRICULTURAL PRACTICES**  
including pesticide-use, waste-water reuse



**CLIMATE CHANGE**

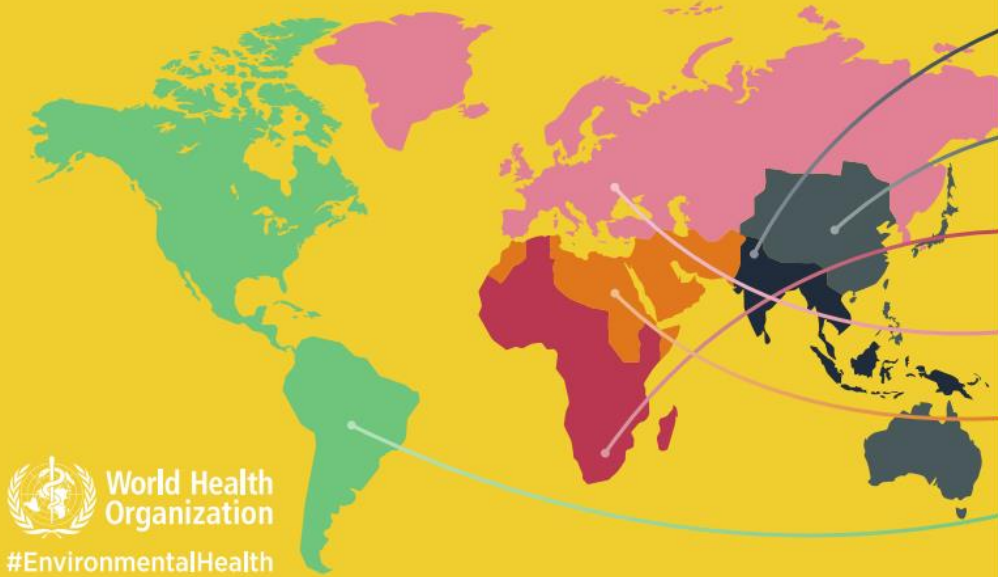


**BUILT ENVIRONMENTS**  
including housing and roads



**23%**  
of all global deaths are linked to the environment.  
That's roughly **12.6 million deaths** a year.

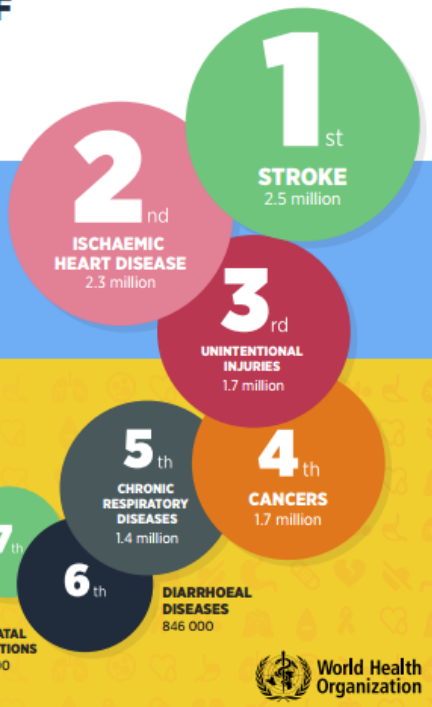
## WHERE IS IT HAPPENING?



- 3.8 million** in South-East Asia Region
- 3.5 million** in Western Pacific Region
- 2.2 million** in Africa Region
- 1.4 million** in European Region
- 854 000** in Eastern Mediterranean Region
- 847 000** in the Region of the Americas

## TOP 10 CAUSES OF DEATH FROM THE ENVIRONMENT

**8.2 million** out of **12.6 million** deaths caused by the environment are due to noncommunicable diseases



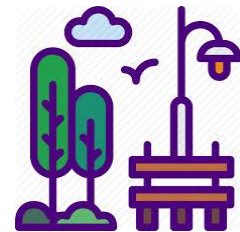
World Health Organization  
#EnvironmentalHealth

## WHO IS MOST IMPACTED BY THE ENVIRONMENT





# Public health through the life course



# Integrating Radiation Protection through the life course



## 3 EXPOSURE SITUATIONS

planned, existing, emergency

## 3 PRINCIPLES

justification  
optimization  
limitation

## 3 CATEGORIES OF EXPOSURE

occupational  
medical  
public

The exposure situations and categories of exposure are combined in the same individual through **the life course**

# Content



- Introduction
- Existing exposure situations

# International Standards

## IAEA Safety Standards

for protecting people and the environment

Radiation Protection and  
Safety of Radiation Sources:  
International Basic  
Safety Standards

Jointly sponsored by  
EC, FAO, IAEA, ILO, OECD/NEA, PAHO, UNEP, WHO



General Safety Requirements Part 3  
No. GSR Part 3



Jointly sponsored by  
EC, FAO, IAEA, ILO, OECD/NEA, PAHO, UNEP, WHO



# International BSS (2014)



IAEA Safety Standards  
for protecting people and the environment

Radiation Protection and  
Safety of Radiation Sources:  
International Basic  
Safety Standards

Jointly sponsored by  
EC, FAO, IAEA, B/O, OECD/NEA, PAHO, UNEP, WHO  
  
General Safety Requirements Part 3  
No. GSR Part 3



## 5. EXISTING EXPOSURE SITUATIONS

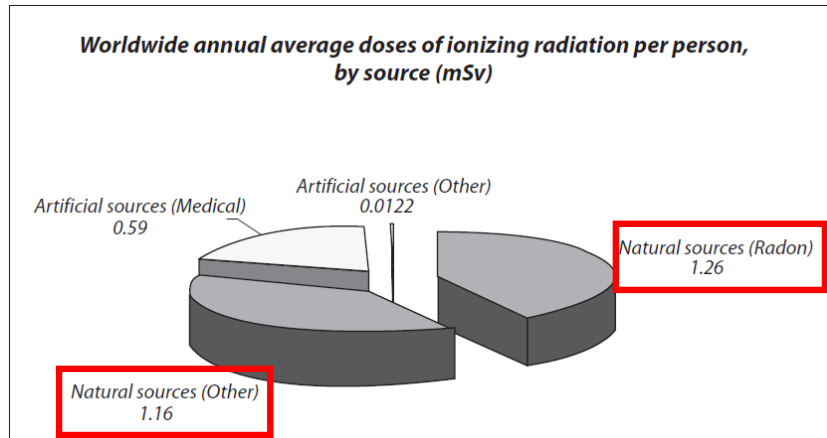
### SCOPE

5.1. The requirements for existing exposure situations in Section 5 apply to:

....

- (c) Exposure due to natural sources, including:
  - (i)  $^{222}\text{Rn}$  and its progeny and  $^{220}\text{Rn}$  and its progeny, in workplaces other than those workplaces for which exposure due to other radionuclides in the uranium decay chain or the thorium decay chain is controlled as a planned exposure situation, in dwellings and in other buildings with high occupancy factors for members of the public;
  - (ii) Radionuclides of natural origin, regardless of activity concentration, in commodities, including food, feed, drinking water, agricultural fertilizer and soil amendments, and construction materials, and residual radioactive material in the environment;

# Naturally occurring sources in our environment



**Table 9.1 Average radiation dose from naturally occurring sources**

Source	Worldwide average annual effective dose (mSv)	Typical annual effective dose range (mSv)
<b>External exposure</b>		
Cosmic rays	0.39	0.3–1 <sup>a</sup>
Terrestrial radiation (outdoors and indoors)	0.48	0.3–1 <sup>b</sup>
<b>Internal exposure</b>		
Inhalation (mainly radon)	1.26	0.2–10 <sup>c</sup>
Ingestion (food and drinking-water)	0.29	0.2–1 <sup>d</sup>
<b>Total</b>	<b>2.4</b>	<b>1–13</b>

<sup>a</sup> Range from sea level to high ground elevation.

<sup>b</sup> Depending on radionuclide composition of soil and building material.

<sup>c</sup> Depending on indoor accumulation of radon gas.

<sup>d</sup> Depending on radionuclide composition of foods and drinking-water.

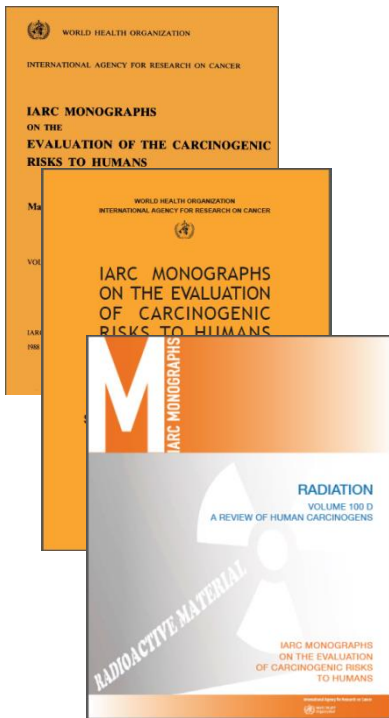
Source: Adapted from UNSCEAR (2008)

# Content



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- Inhalation of natural radioactivity: Radon

# NORM IX theme: "Science – Awareness – Solutions"



1988, 2001, 2012

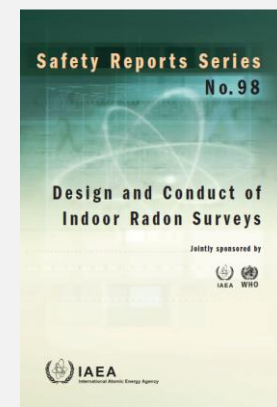
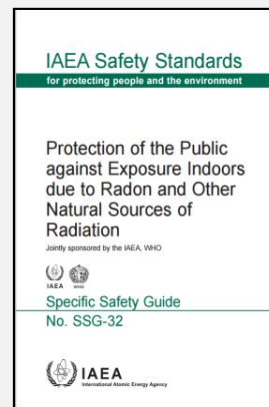
with IAEA



Radon training material



Webinars: Targeting Radon





# Reference levels for radon

## Residential studies



Scientific evidence suggests 3-14% of lung cancers are due to exposure to indoor radon

Annually **around 100,000 deaths** from lung cancer are due to indoor radon exposure worldwide

Most lung cancer deaths related to radon are associated with **low / moderate concentrations** in normal dwellings

Epidemiological studies do not support the evidence of a "safe" threshold level

WHO recommends a reference level as low as reasonably achievable:

- **100 Bq/m<sup>3</sup>** justified as an effective reduction of radon-associated health hazards expected
- If this level cannot be implemented because of country-specific conditions, the reference level should not exceed **300 Bq/m<sup>3</sup>**

Note: Recent miners studies show a statistically significant risk of lung cancer after low radon exposures, which is compatible with radon in homes

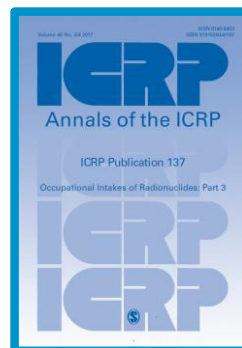
# An evolving approach

## Reference levels for radon

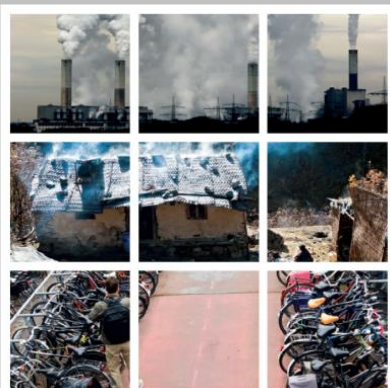
Publication	Year	Public	Workers
WHO handbook	2009	100-300 Bq/m <sup>3</sup>	N/A
International BSS	2011 (2014)	300 Bq/m <sup>3</sup>	1000 Bq/m <sup>3</sup>
EC Council Directive	2013	300 Bq/m <sup>3</sup>	300 Bq/m <sup>3</sup>
ICRP 126	2014	300 Bq/m <sup>3</sup>	300 Bq/m <sup>3</sup>

## Conversion factors from concentrations to dose

Bq/m<sup>3</sup> → mSv/y

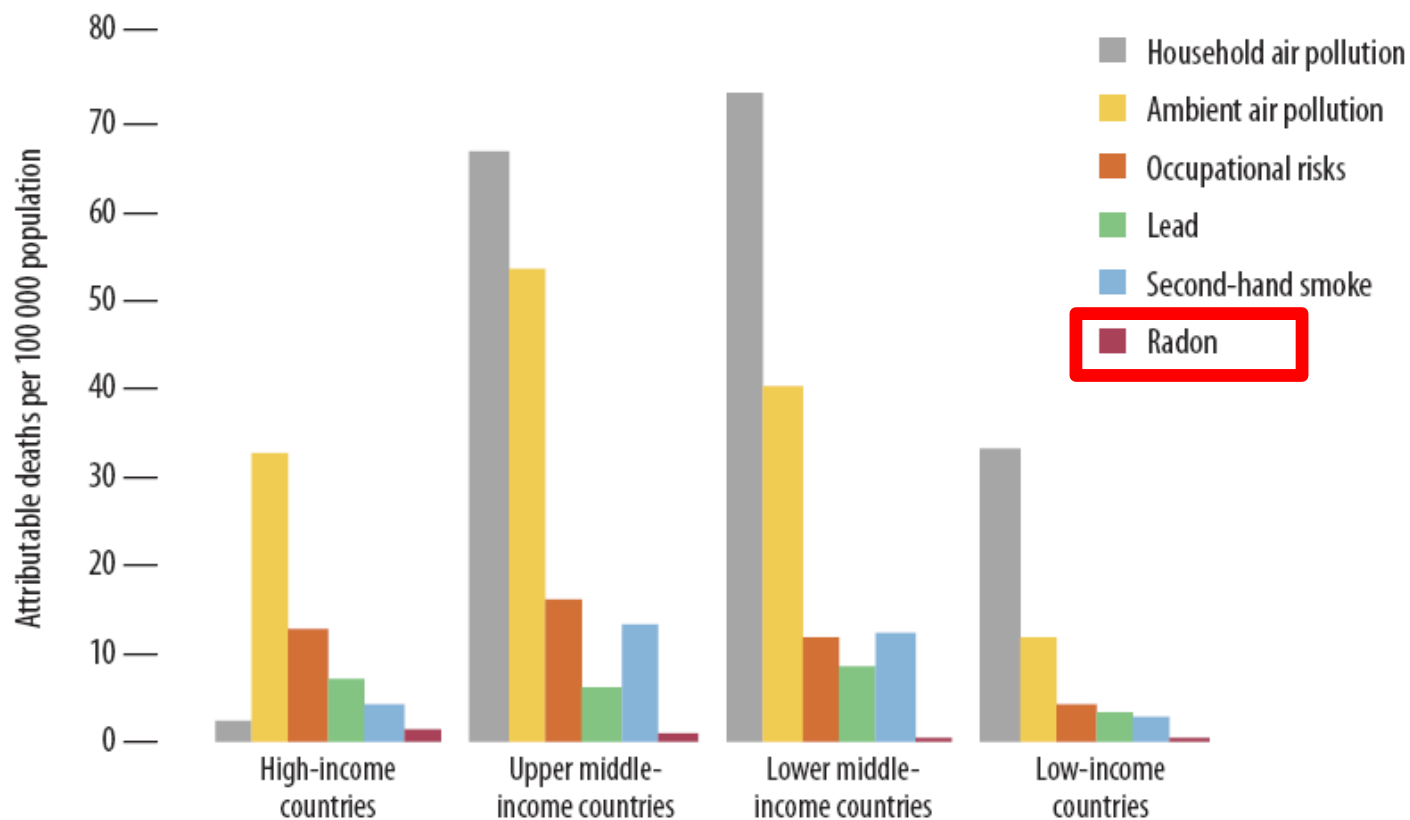


# Radon - a contributor to indoor air pollution



PREVENTING NONCOMMUNICABLE DISEASES (NCDs) BY REDUCING ENVIRONMENTAL RISK FACTORS

Figure 3. NCD deaths attributable to environmental risks by income level



Sources: Air pollution: (4) for 2012; other risks: (3) for 2015.

# 1<sup>st</sup> WHO Global Conference on Air Pollution and Health



## Clean Air for Health - Geneva Action Agenda

### First WHO Global Conference on Air Pollution and Health – Conference summary report: **CLEAN AIR FOR HEALTH: Geneva Action Agenda**

Geneva, 1 November 2018 – At the conclusion of the first WHO Global Conference on Air Pollution and Health, participants agreed an aspirational goal of reducing the number of deaths from air pollution by two-thirds by 2030. Leaders from national and city governments, intergovernmental organizations, civil society, philanthropy, research and academia considered the scientific evidence on air pollution and health and emphasized the urgent need for bold and prompt action to address this health crisis.



- **Urgent need for bold and prompt action**
- **Aspirational goal of reducing the number of deaths from air pollution by 2/3 by 2030**

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# Radioactivity in food and water

## BSS reqs. 5.22 and 5.23



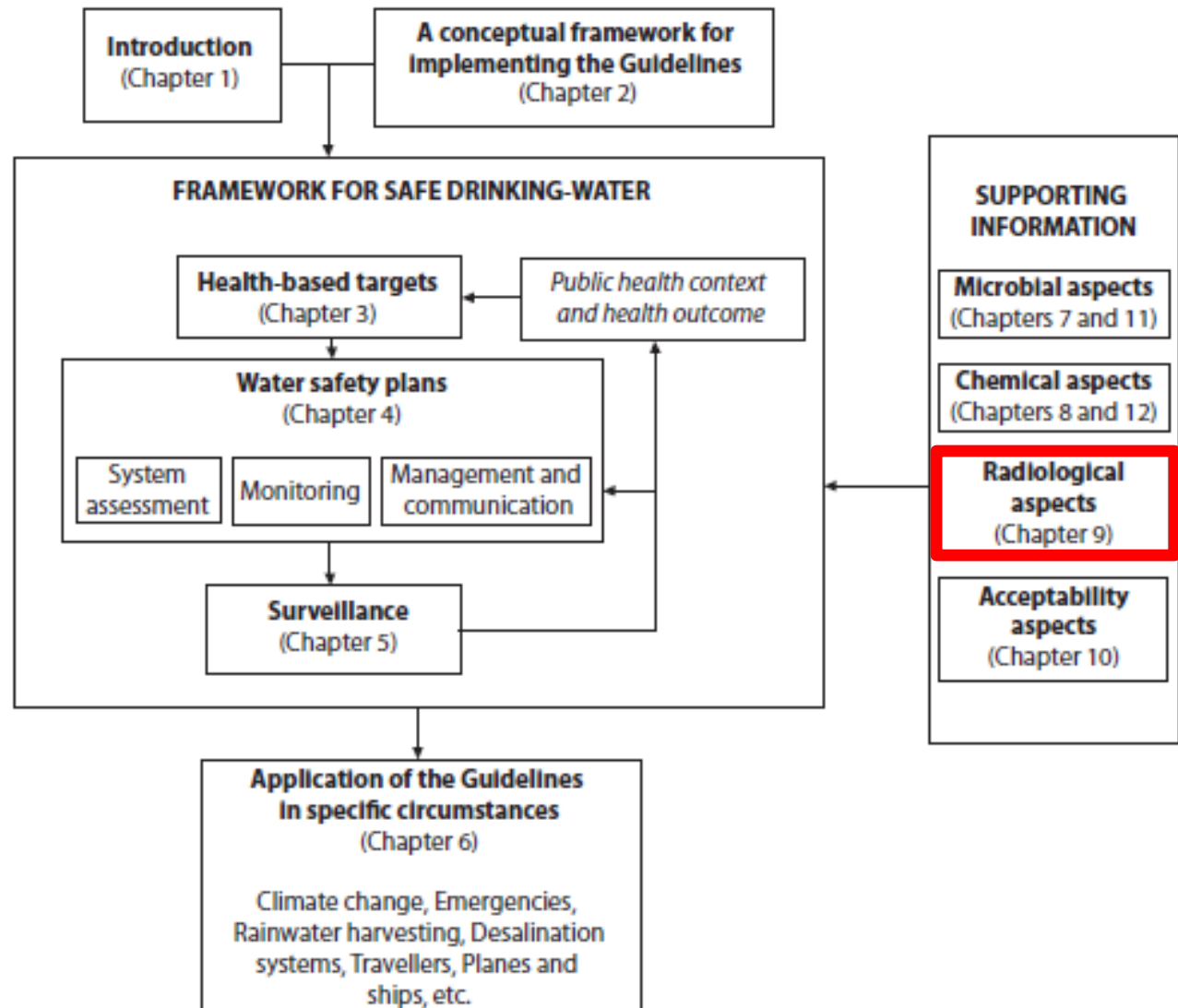
The regulatory body or other relevant authority shall establish specific **reference levels** for exposure due to radioactivity in **food, drinking water**, and other commodities, each of which shall typically be expressed as, or be based on, an annual effective dose that does not exceed a value of about 1 mSv

They have to consider the guideline levels for:

- Radionuclides contained in drinking water published by WHO (i.e. **GDWQ**)
- Radionuclides in food traded internationally published by the Joint FAO/WHO Codex Alimentarius Commission (i.e. **Codex Alimentarius**)



# Drinking-water quality



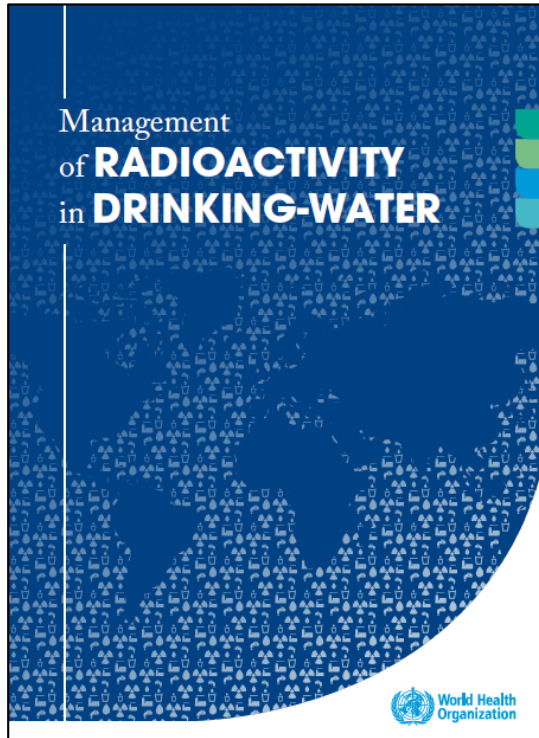
# WHO Guidelines for Drinking-Water Quality



- For use for an **existing exposure situation**, not for an emergency exposure situation
- Applies to radionuclides of both **natural and artificial** origin
- Uses a **conservative approach** providing an “Individual Dose Criterion” (IDC) of **0.1 mSv/y** from ingestion of drinking water – this represents a **very low level of health risk**, and should not be interpreted as mandatory
- Regulatory authorities may establish a national standard at the **IDC** level or greater, but generally less than the BSS **reference level** of 1 mSv per year, depending on the prevailing circumstances
- Gives practical ways of measuring radionuclide content



# Guidance for implementation of GDWQ Chapter 9



## Purpose

Provide practical guidance to support interpretation and implementation of the GDWQ in order to take appropriate action

## Audience

Organizations that set or enforce standards related to, or manage risks from, radioactivity in drinking-water

## Format

Written in the style of Q&As to enable easier reading of the issues of interest

Chapter 1

**NON-  
EMERGENCY  
SITUATIONS**

Chapter 2

**EMERGENCY  
SITUATIONS**

Chapter 3

**SUPPORTING  
INFORMATION**

Chapter 4

**CASE  
STUDIES**

# Putting radiation risks in perspective

- **Radiological risks are normally small** compared with the risks from microorganisms and chemicals that may be present in drinking-water
- Except in extreme circumstances, the radiation dose resulting from the ingestion of radionuclides in drinking-water is **much lower** than that received from other sources of radiation



# Food safety



**Food safety** contributes to food security, human health, economic prosperity, agriculture, market access, tourism and sustainable development.

First ever **UN World Food Safety Day** celebrated on **7 June 2019** with the theme: “***Food safety is everyone’s business***”.

- FAO and WHO were designated to lead efforts in promoting food safety, joining forces to assist countries to prevent, manage and respond to risks along the food supply chain, working with food producers and vendors, regulatory authorities and civil society stakeholders.



**Eat it safe**

Everyone has a right to safe, healthy and nutritious food



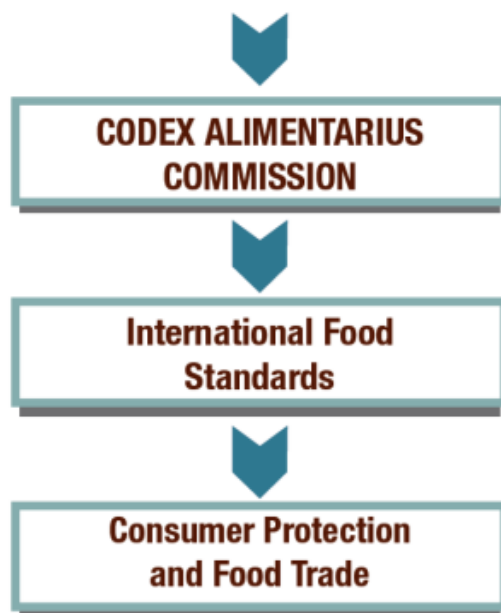
**Team up for safety**

Food safety is a shared responsibility



# The Scientific Basis of Codex

## Joint FAO/WHO Scientific Advice Programme

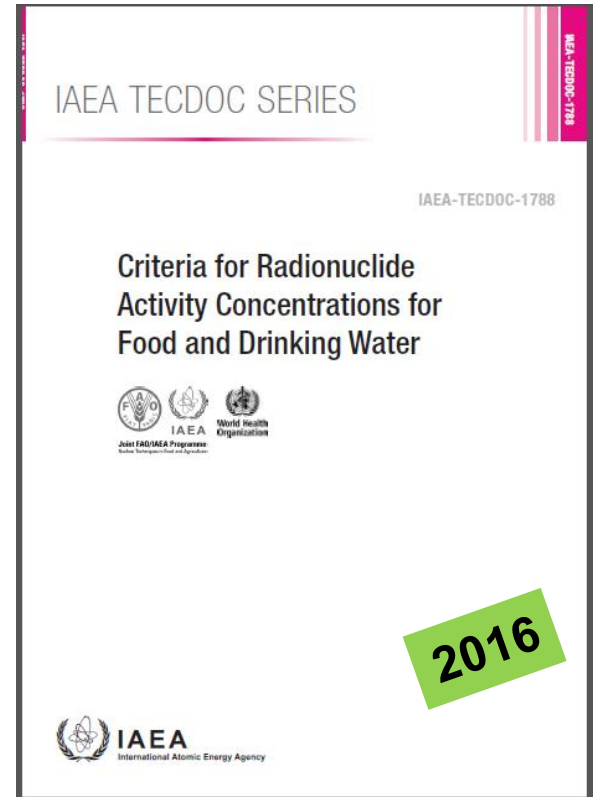
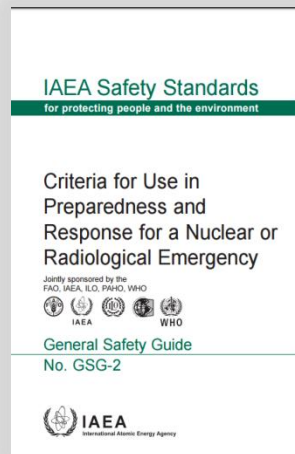
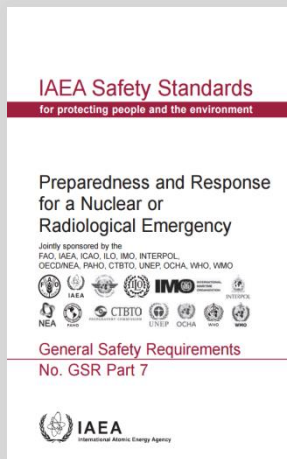
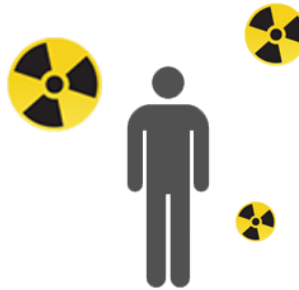
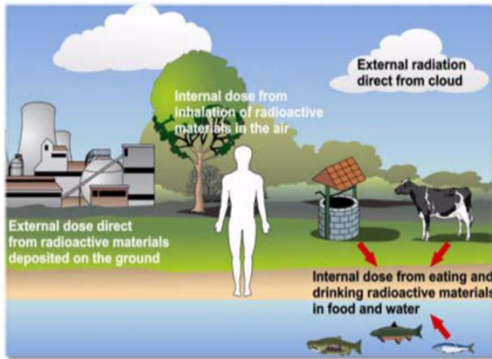


**Food Safety**  
**Health/Nutrition Claim/Labeling**  
**Fortification – Food for Special Dietary Uses**  
**Safety Assessment of Novel Technologies**

# CODEX guidelines for radionuclides in food in international trade



- Applies only to **food with contamination following a nuclear or radiation emergency**
- Applies only to **international trade**
- CODEX guideline levels defined in terms of 4 radionuclide groups for 2 categories of foods (infant and non-infant foods)
  - Activity concentrations derived by assuming 10% of the diet is imported contaminated food (equivalent to 1 mSv ingestion dose over a year)
  - Adult consumption rate of 550 kg/y and infant 200 kg/y



# Radionuclides in Food and Drinking Water in Non-Emergency Situations

A IAEA/FAO/WHO Joint Project



**NEW!!**

To address several gaps and inconsistencies

- Drinking water (tap water) is the only commodity where specific reference levels for radionuclides are established at national level worldwide. Packaged water, natural mineral water are handled differently.
- For radionuclides in food, no international guidelines have yet been produced to support the establishment of specific reference levels equivalent to an annual dose of 1000  $\mu\text{Sv}/\text{year}$  in non-emergency situations.
- Competent Authorities for food safety and quality tend to address human made radionuclides in food but not natural radionuclides in food. However, it is the natural radionuclides in food that dominate the radiation exposure by ingestion in normal circumstances.
- Lack of an authoritative reference data set for levels of natural radionuclides in food since the UNSCEAR 2000 report

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# Discussion

The WHO public health perspective

- Aims to reduce the overall population risk and the individual risk for people exposed to high radioactivity concentrations
- Follows a conservative approach
- Includes a worker's health perspective
- Is inclusive of informal industries
- Promotes clear risk communication strategies
- Promotes health research



NORM IX theme: “Science – Awareness – Solutions”