

Fukushima : current evaluations of the health risks and  
potential implications for the medical emergency plans  
in Belgium

ABR/BVS scientific meeting

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Effects of radiation exposure of children:  
the new UNSCEAR report  
Highlights and critical review

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# Effects of ionizing radiation and Safety Standards: major international players

- EU level:
  - Art 31 Group of Experts: scientific evaluation and preparation EU regulation
- World level:
  - **UNSCEAR**: scientific evaluation (27 countries)
  - **ICRP**: scientific evaluation and recommendations RP
- In parallel with EU: Safety Standards **IAEA** (Fundamentals, Requirements, Guides): « International BSS » (IAEA, FAO, ILO, NEA, WHO, PAHO)
- In addition:
  - **CRPPH** (NEA/OECD): think tank
  - **BEIR** (NAS-US): scientific evaluation

# Developments in Radiation Protection Policy

- Scientific Research
- **Evaluation of the scientific data: 3 pitfalls**
  - Value judgments (even in scientific evaluation)
  - Mandates and conflicts of interest
  - Weight of dominant paradigms
- Implications: **same pitfalls**
- **Interest of having various think tanks**

# Context of the report

- 2005 : UN Chernobyl Forum Report:
  - « The end of the story »
  - **Dispute** around number of attributable deaths, morbidity of children, minimization
- 2008 (pub. 2011): UNSCEAR Chernobyl report  $\cong$  Forum
- 2011: Art 31 Chernobyl review (RP 170: Recent scientific findings and publications): more balanced, « ignored » by U
- 2012 UNSCEAR meeting:
  - **The « 100 mSv comeback »**
  - Difficult « agreement » on an « Attributability report » aiming to justify UN Forum statements
- 2013 UNSCEAR meeting:
  - Attributability report still not published: Working Party .....
  - **The « shadow » of Fukushima's.....children**

# The children report: classical UNSCEAR pyramid

- Key findings for the General Assembly
- Scientific Annex:
  - Sources of exposure
  - Anatomical development and physiology
  - Dosimetric aspects
  - Health effects
- Appendixes:
  - A. Neoplasms
  - B. Deterministic effects/tissue reactions
  - C. Hereditary effects

# Consultants

Coordination, compilation of UNSCEAR published data and «**leadership**»: F. Mettler

- Dosimetric aspects: D. Nosske
- Neoplasms (**epidemiology**) : R. Shore
- Deterministic effects (**radiotherapy**): L.S. Constine

# Children?

Under the age of 20, including:  
infants,  
children  
and adolescents

**NB: Reluctance to distinguish sub-categories**

Excluded: in utero (“already covered”) and  
animal data

# Dosimetric aspects: at a glance

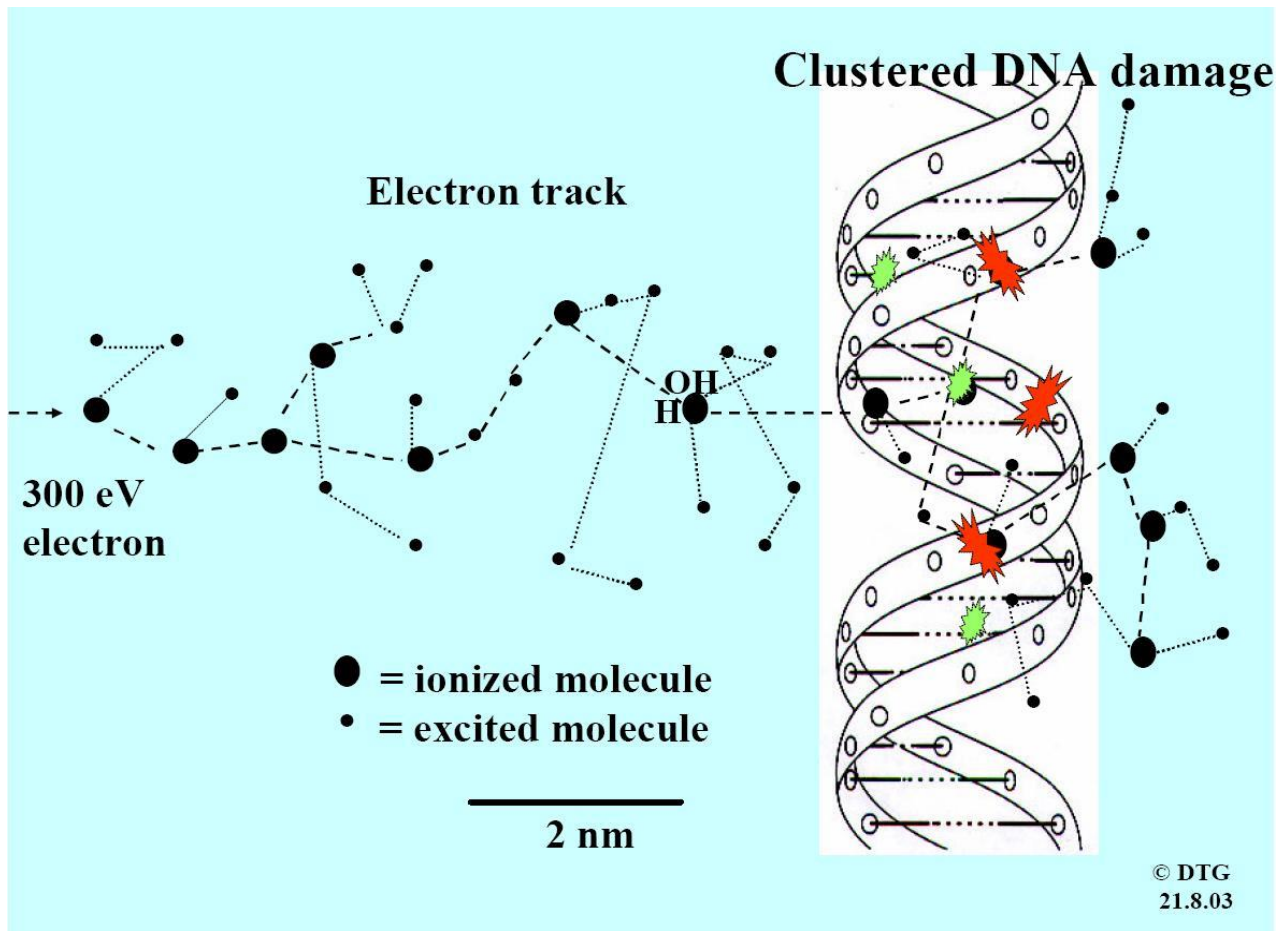
- External exposure:
  - smaller body diameters, closer to the ground
  - factors to correct for the difference between irradiation of children and adults from the ground: about 1.4 for infants and 1.1–1.2 for children.
- Internal exposure:
  - organs closer together, metabolism, physiology, ...
  - substantial differences with age in the dose per unit intake of radionuclides (iodine-131, strontium-90, radium-228, ...)



# Dosimetric aspects: critical review

- Few discussions,
- **just copying** ICRP documents, no critical evaluation .....
- Agreement on the need to use organ/tissue doses (instead of effective dose) for evaluating health effects in children,
- but **in depth reflexion on radiotoxicological issues is lacking** (for example, HTO v/ OBT)

Studies on embryos: HTO v/ tritiated arginine:  
**factor 40 000!** (factor 4 for Sv/Bq!)  
(EU RIHSS; HPA; livre blanc ASN)



# Thinking the unthinkable

**Recent scientific findings and publications on  
the health effects of Chernobyl**

**RADIATION PROTECTION NO 170**

**2011**

# Children's morbidity

- **Many claims** concerning the health of children in the contaminated territories around Chernobyl, which seem to suffer from **multiple diseases and co-morbidities** with repeated manifestations
- **Reports from international organizations did not give until now much interest: “psycho-social”**
- **But most studies not available in English and not translated!**

# Children's morbidity: recent initiatives

- Series of **IRSN studies:**
  - **Rats** exposed to  $^{137}\text{Caesium}$  contamination during several months through drinking water (150 Bq/day/animal: comparable with a typical **low intake** in the contaminated territories)
  - *Although the animals tested in these studies did not show induced clinical diseases, a **number of important biological effects** were observed on various systems: increase of CK and CK-MG, decrease of mean blood pressure and disappearance of its circadian rhythm; EEG modifications, perturbations of the sleep-wake cycle, neuro-inflammatory response, particularly in the hippocampus, etc*
- **Not mentioned and even no quotation of references in the U report**

# Children's morbidity: recent studies

- Series of longitudinal studies initiated recently in Ukraine in conjunction with the **US University of South Carolina**:
  - Stepanova 2008: 1993 to 1998: significant reduction in red and white blood cell counts, platelet counts and haemoglobin with increasing residential soil contamination (cfr Techa River)
  - Svendsen 2010 : 1993 to 1998: spirometry: statistically significant evidence of both airway obstruction and restriction with increasing soil contamination (immune mechanism?)
- **“The optimism of the UN reports may be based on too few studies published in English, conducted too soon after the event to be conclusive”.**

**Not quoted although sent to consultants**

# Children's morbidity and internal exposures: thinking the unthinkable

General assumption: equivalence of risk for  
external and internal exposures

For (**chronic**) **internal exposures**,  
a major underlying issue could be  
**the inadequacy of the equivalent/effective  
dose as risk indicator for all types of effects.**

# Neoplasms:

## General flavour:

After radiation exposure, tumour induction in children compared to in adults is **quite variable and depends on the tumour type**, specific assumptions and the various risk models used.

**Full stop.....**



# Age-related radiosensitivity for cancer-induction

- for about 25% of tumour types, children are clearly **more radiosensitive** regardless of the model. These include **leukaemia, and thyroid, skin, breast and brain cancer.**
- for about 15% of tumour types (including colon and bladder), **same** radiosensitivity as adults.
- for about 10% of tumour types (notably lung cancer), **less** sensitive than adults.
- for about 20% of tumour types (including oesophagus cancer), the data are **too weak to draw a conclusion**
- finally, for about 30% of tumour types (including myeloma, Hodgkin's disease, kidney, prostate, rectum and uterus cancer), there is only a **poor or no relation between radiation exposure** and risk.

# Neoplasms: critical review (1)

Unique message: children induction of tumors compared to adults depends on the tumor type.

This gives the false impression that there is no scientific reason for better protecting infants and children.

In fact, as shown in the last reviews of the atomic-bombing, **both the ERR and the EAR for all solid cancers were and still continue to be higher for younger ages at exposure**, pointing to **a lifetime risk for all solid cancers consistently higher** for low ages at exposure (by a factor of 2 or 3 depending on the models and of the compared ages).

***This should have been the first message to the General Assembly .***

***Finally simple quotation of UNSCEAR 2006 report....***

# Neoplasms : critical review (2)

Other important aspects not underlined:

- age at apparition of the cancer:
  - average years of life lost per cancer case greater for those exposed at young ages
  - very low latency times for some cancers
  - near the quantitative aspect of the total number of cancers, this **qualitative** and humane aspect should be highlighted
- the differences between age sub-categories: in particular the higher sensitivity at ages at exposure below 5 y for radiation-induced thyroid cancers.

# Deterministic effects: same key message

There are some instances in which childhood exposure poses **more** risk than adult exposure (e.g. for **cognitive defects, cataracts, and thyroid nodules**). There are other instances where the risk appears to be about the **same** (e.g. neuroendocrine) and there are a few instances where children's tissues are **more resistant** (e.g. lung function, marrow and ovarian failure).

# Deterministic effects: critical review (1)

- An important issue is that the large majority of data are coming from the field of radiotherapy, meaning high acute doses, while data are very scarce for chronic exposures, particularly for chronic internal exposures of children.
- There are still many questions regarding radiation-induced non-cancer effects in general and the role of age at exposure in particular, including regarding the mechanisms and the role of epigenetic effects. Research is still on-going (circulatory diseases, cognitive effects, ...).
- Some unexpected (in general or at the doses considered) radiation-induced non-cancer effects **cannot be a priori excluded** and are suggested by some recent publications.

# Deterministic effects: critical review (2)

- Here also, qualitative human aspects related to the young age of apparition must not be forgotten.
- Focussing on the fact that childhood exposure poses more risk than adult exposure for some effects, but not for others, gives the wrong impression that there is globally no reason for specially protecting infants and children.

# Hereditary effects

- Conclusion: “no heritable effects in humans due to radiation exposure have been specifically identified”
- Not highlighted:
  - Animal studies
  - There remain many uncertainties, particularly on long term effects, as only a few human generations have been observed.

# ***Challenges for the Radiological Protection for the next 50 years: UNSCEAR is a good illustration***

- Political context and conflicts of interest (Chernobyl, Fukushima, ....): danger for **credibility**
- Misuse of the **evidence-based** approach
- Lack of **precautionary attitude within scientific evaluation**
- **Scientific reductionism** and mechanistic vision of the world: increasing gap with society



# Credibility

- A clear goal for several influent players was to **reassure** the Japanese population, particularly about the health of their children and thus to **minimize** as much as possible the possible radiation effects from exposure of children.
- The Belgian delegation played a crucial role in trying to reach a more balanced view.

# Evidence-based approach:

current dominant scientific paradigm

The almost only concern is to avoid concluding that a causal relationship exists before it is **firmly proved (hard evidence)**.

The main dominant concern is:  
**avoid the false positives**

# Misuse of evidence-based approaches: long term effects in a rapidly moving world

For society the main concern of the experts is expected to be the protection of health.

When there is **scientific plausibility** (**enough evidence**) of the existence of a risk of serious harm, **action is needed!**

Even if there is still uncertainty!

The main societal concern is:

**avoid the false negatives!**

# UNSCEAR 2012: agrees on the principle .....

The Committee's **strategic objective** for the period 2009-2013, endorsed by the General Assembly, in its resolution 63/89, is “to increase awareness and deepen understanding among authorities, the scientific community and civil society with regard to levels of ionizing radiation and the related health and environmental effects as **a sound basis for informed decision-making on radiation related issues**”.

As underlined **in the last report to the General Assembly** (A/67/46, paragraph 23), “that strategic objective highlighted the need for the Committee to provide information on the strengths and limitations of its evaluations, which are often not fully appreciated. **This involves avoiding unjustified causal associations (false positives) as well as unjustified dismissal of real health effects (false negatives).**”

# ...but the culture did not change!

In many parts of the documents , too much importance is given to the avoidance of false positives (by highlighting all possible bias for an association between effect and exposure) in comparison with the avoidance of false negatives, while possible dismissal of real health effect of radiation is a major concern for responsible decision-makers.

- **Good illustrated by the exclusively critical reaction about the new low dose reports (Pearce, Kendall, ...)**
- **And by the.... comeback of the 100 mSv myth!**

# Coming back of the « 100 mSv »

- At stake in the attributability report
- There is « no compelling epidemiological evidence of radiation-induction of cancer in a mixed population under 100 mSV »
- As a consequence no effect could be « attributed » to radiation under 100 Sv and **even inference** of risk for the future under this dose would be « non-scientific » .....

**As formulated by a participant: « They forget decades of biological research »**

# Radiation-induction of cancer : overall judgment (U 2000)

On the basis of the current evidence :

- no threshold;
- cancer risk rising as a function of dose;
- various patterns: L and LQ « the most scientifically defensible approximation »

# *Challenges for the Radiological Protection for the next 50 years: UNSCEAR is a good illustration*

- Political influences (Chernobyl, Fukushima, ....): danger for **credibility**
- Misuse of the **evidence-based** approach
- **Lack of precautionary attitude within scientific evaluation**
- **Scientific reductionism** and mechanistic vision of the world: increasing gap with society



# Precaution in Science is relevant!

Although frequently limited to the decision-making processes in situations of uncertainty, the precautionary approach is also relevant and appropriate in science.

As underlined in the COMEST report from UNESCO, the precaution approach in science includes:

- a focus on risk plausibility rather than on hard evidence
- a responsiveness to the first signals (“early warnings”)
  - a systematic search for surprises (“thinking the unthinkable”), particularly for possible long term effects

**Refused by UNSCEAR, as illustrated by the issue of chronic internal exposures, and the reluctance to underline uncertainties (research needs)**

# Research needs

**First absent in the report...**

Then a short list elaborated during the meeting

**Illustration of a lack of interest for possible false negatives**

« L'expertise n'a pas une qualité de pensée à la hauteur des problèmes qu'elle pose à la société »

(Jean-Pierre Dupuy)

Aurait-il raison? .....