



United Nations Scientific Committee
on the Effects of Atomic Radiation



International Conference on
RADIATION PROTECTION IN MEDICINE
Setting the Scene for the Next Decade

**Can we attribute health effects to
medical radiation exposure?**

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EVALUATING RADIATION SCIENCE FOR INFORMED DECISION-MAKING

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- Introduction
- Basic aspects
- Deterministic (tissue) effects
- Stochastic effects
- Conclusions



- The UN General Assembly has encouraged the Scientific Committee at its earliest convenience to submit the report on the attribution of health effects due to radiation exposure.
- The Fourth Committee of the UN General Assembly has discussed the Scientific Committee's report on 13 Nov. 2012 and adopted a resolution which welcomes with appreciation the scientific report on attributing health effects to radiation exposure and inferring risks and the report on uncertainties in risk estimates for cancer due to exposure to ionizing radiation.



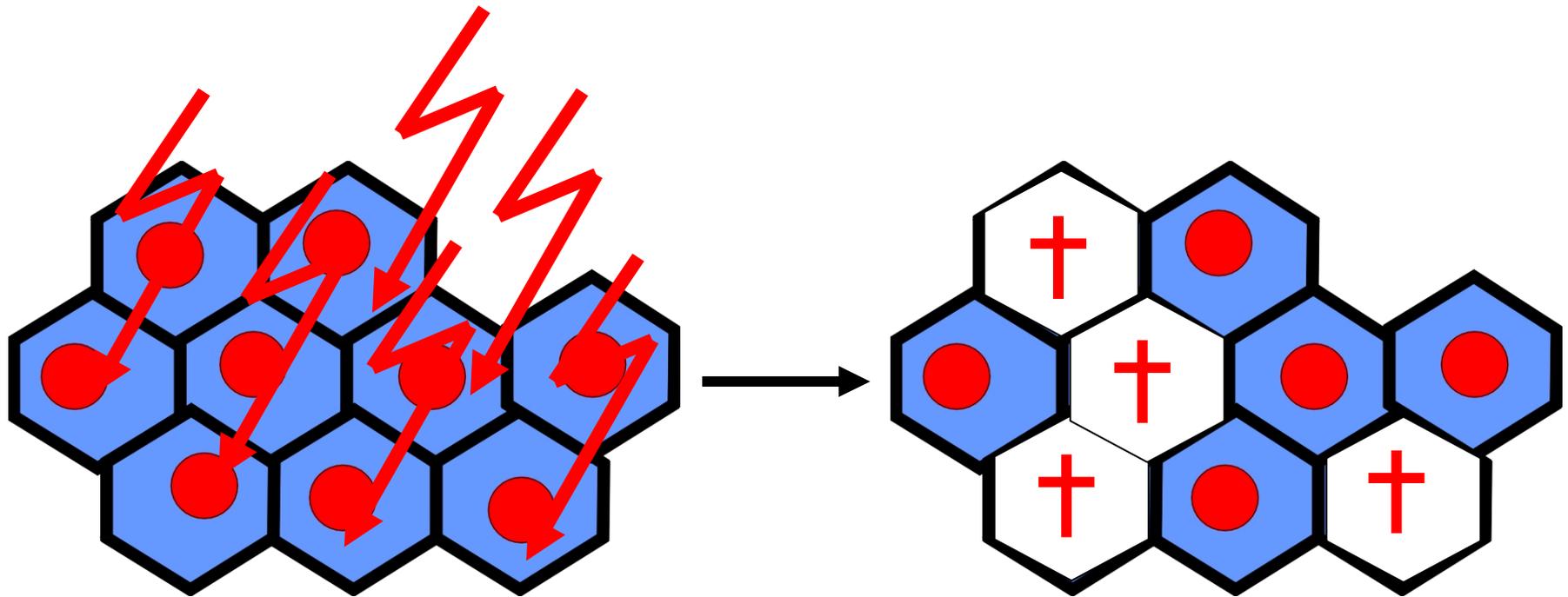
Basic aspects



- First of all, one has to be very careful to distinguish „health effect“ (something that is actually observed) and „health risk“ (something that is expected).
- In general, health effects are related to the past and health risks to the future.
- It makes a difference to attribute in the individual case or in the case of a population.



Deterministic (tissue) effects





Skin burn after interventional cardiology procedure

- 69 year old patient with a long-standing heart-disease;
- a diagnostic nuclear medicine myocardial imaging study showed severe ischaemia in the distribution of the left anterior descending coronary artery;
- underwent a cardiac catheterization that included several attempts at coronary angioplasty (dilatation) and stenting. The fluoroscopy time was recorded as 34 minutes. There were 50 cine runs with a total of about 6,200 frames.





Why attributing this health effect to ionizing radiation?



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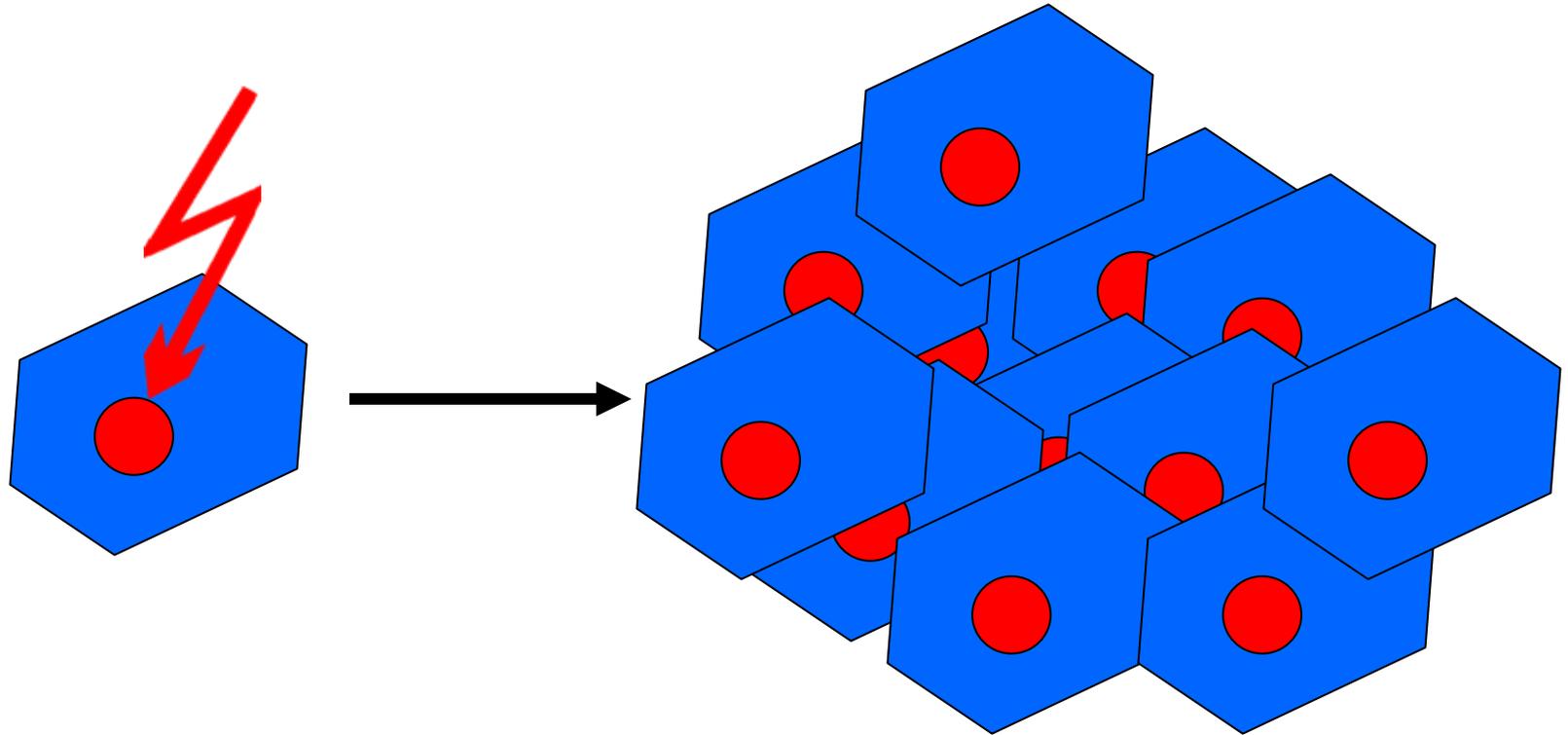
- The lesion appeared shortly after the intervention;
- The temporal sequence of the appearance of reddening, itching followed by skin breakdown within a few weeks and non-healing ulceration at about 6–12 months is characteristic of many radiation burns following high doses;
- The site of the lesion is consistent with a right anterior oblique projection that would be utilized for visualization of the left anterior descending coronary artery;
- A review of the actual images from the procedure showed an exact correlation with anatomical structures underlying this lesion;
- The size of the lesion was consistent with the diameter of the radiation beam used for this procedure.

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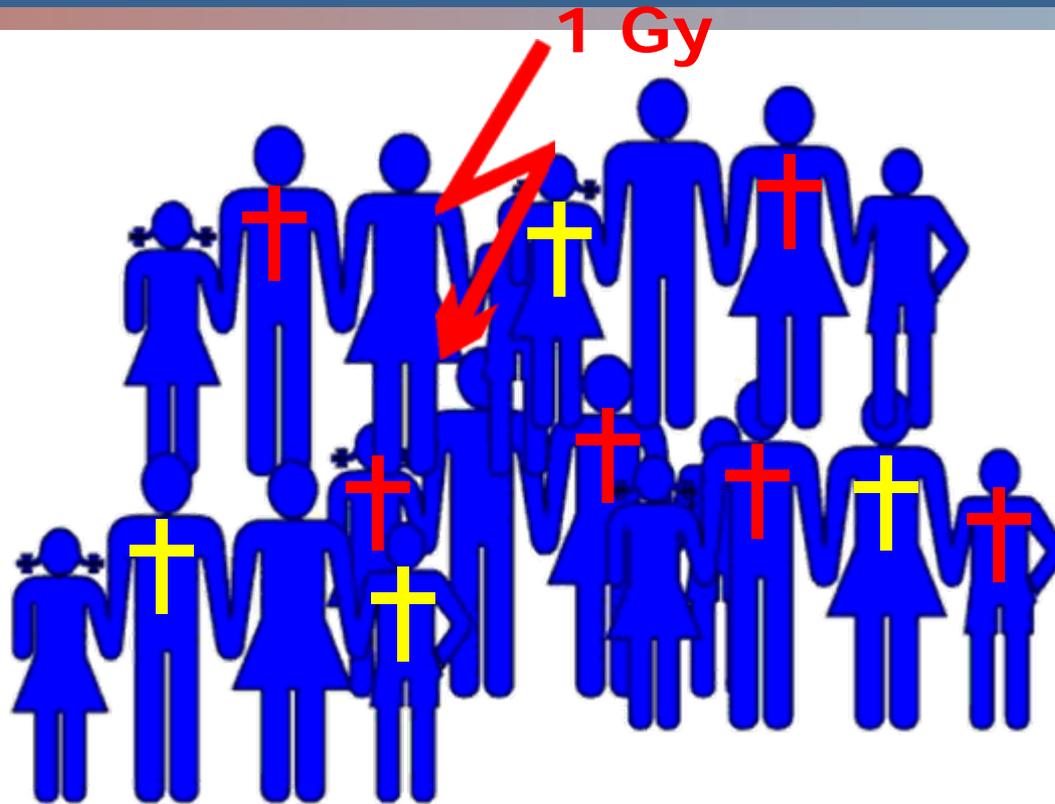
Stochastic (cancer) effects



tumour



Problem: lack of a biomarker



20% spontaneous cancer deaths

10% additional cancer deaths due to 1 Gy



A problem in population studies: Dose



- A serious problem in population studies is to overcome the statistical fluctuations.
- With decreasing dose uncertainty increases (not linearly, but to the square!).
- Thus, it is not surprising that for adults a statistically significant increase in radiation-induced cancer deaths is seen only from about 100 mSv upwards.



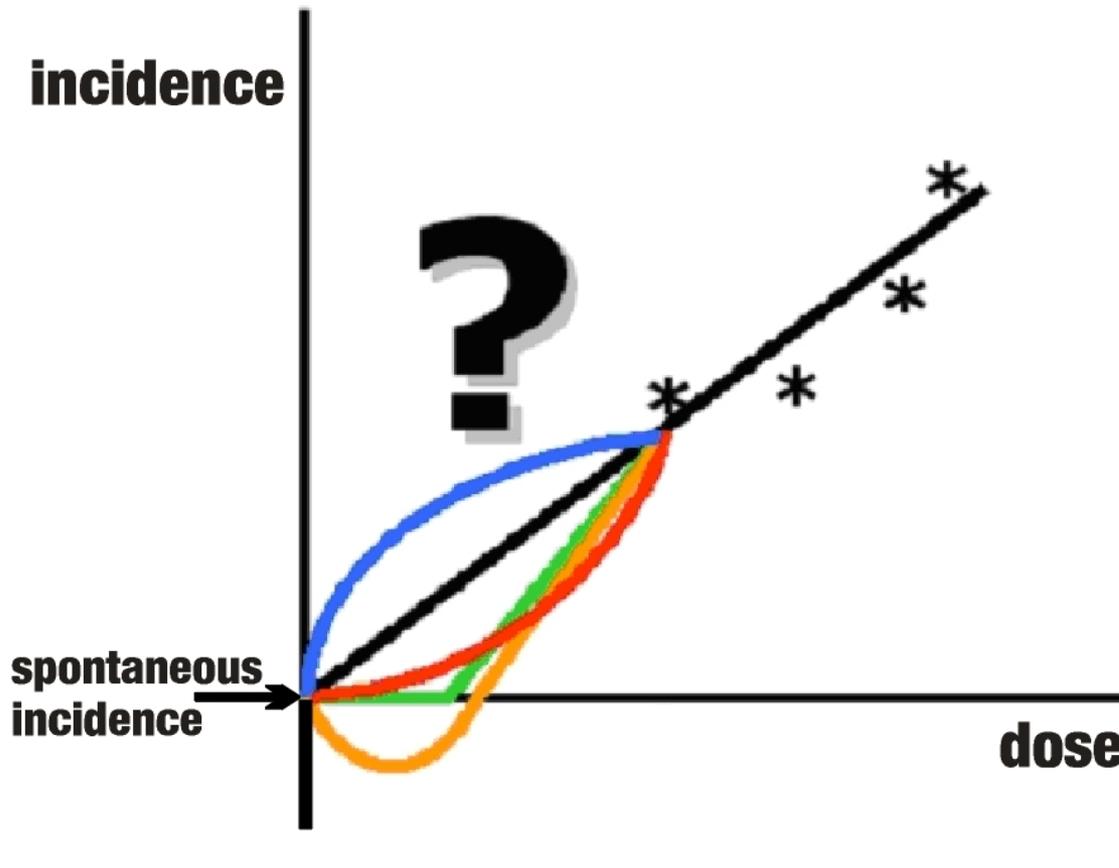
Definition of dose categories



<u>Dose category</u>	<u>Range of absorbed dose</u> (for low-LET radiation)
High dose	> 1 Gy
Moderate dose	100 mGy – 1 Gy
Low dose	10 mGy – 100 mGy
Very low dose	< 10 mGy



Various possibilities of extrapolation from the moderate into the low and very low dose range





Conclusions (1)



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- An observed health effect in an individual could be unequivocally attributed to radiation exposure if the individual were to experience tissue reactions (often referred to as “deterministic” effects), and differential pathological diagnosis were achievable that eliminated possible alternative causes.
- Other health effects in an individual that are known to be associated with radiation exposure — such as radiation-inducible malignancies (so-called “stochastic” effects) — cannot be unequivocally attributed to radiation exposure, because
 - radiation exposure is not the only possible cause and
 - there are at present no generally available biomarkers that are specific to radiation exposure.

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Conclusions (2)



- An increased incidence of stochastic effects in a population could be attributed to radiation exposure through epidemiological analysis — provided that, inter alia,
 - the increased incidence of cases of the stochastic effect were sufficient to overcome the inherent statistical uncertainties.
- Although demonstrated in animal studies, an increase in the incidence of hereditary effects in human populations can not presently be attributed to radiation exposure; one reason for this is the large fluctuation in the spontaneous incidence of these effects.



Conclusions (3)



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- In general, increases in the incidence of health effects in populations cannot be attributed reliably to chronic exposure to radiation at levels that are typical of the global average background levels of radiation.
- The reasons are:
 - the uncertainties associated with the assessment of risks at low doses,
 - the current absence of radiation-specific biomarkers for health effects and
 - the insufficient statistical power of epidemiological studies.
- Therefore, the Scientific Committee does not recommend multiplying very low doses by large numbers of individuals to estimate numbers of radiation-induced health effects within a population exposed to incremental doses at levels equivalent to or lower than natural background levels.

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Conclusions (4)



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- The Scientific Committee notes that public health bodies need to allocate resources appropriately, and that this may involve making projections of numbers of health effects for comparative purposes.
- This method, though based upon reasonable but untestable assumptions, could be useful for such purposes provided that
 - it were applied consistently,
 - the uncertainties in the assessments were taken fully into account, and
 - it were not inferred that the projected health effects were other than notional.

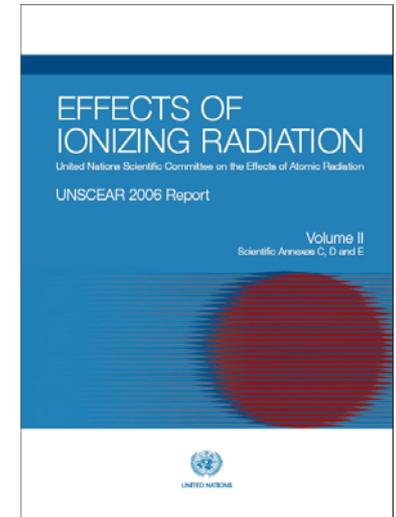


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Thank you for your attention!

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