Age at death from a radiation-induced cancer

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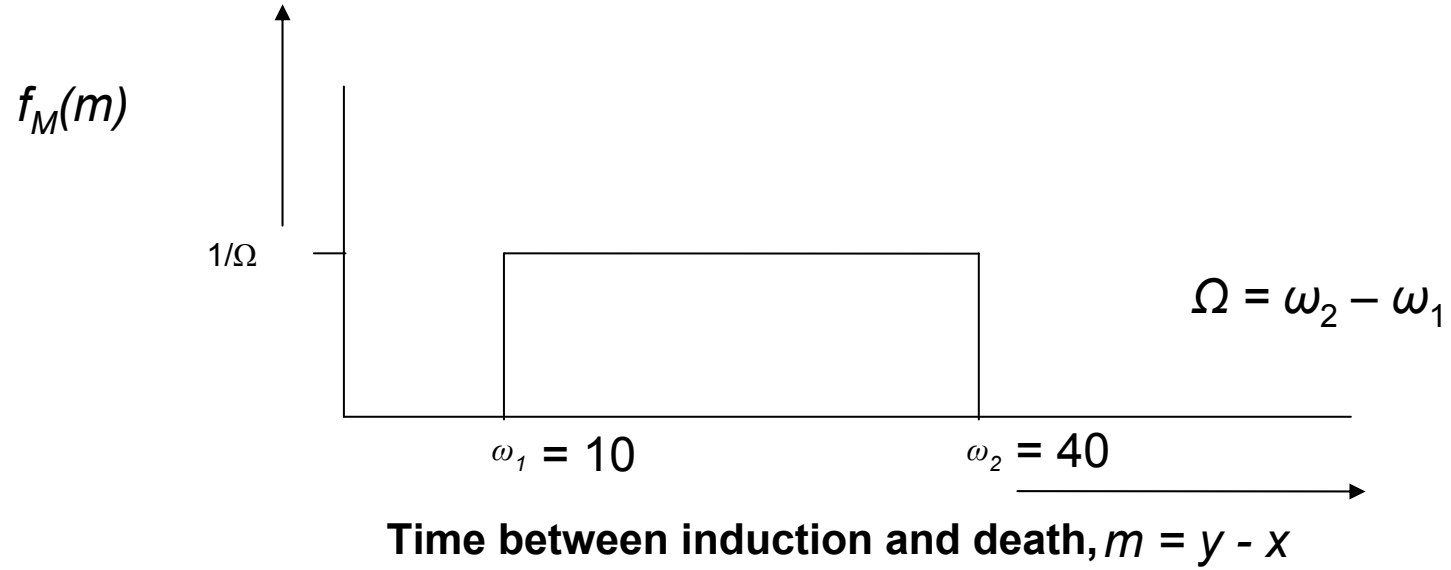
- The **loss of life expectancy** among the public after a big nuclear accident has been calculated to be **small**.
- But this will be an **average figure** across the population.
- What about those unfortunate people who actually contract a fatal cancer as a result of radiation exposure – the **radiation cancer victims**?
- At **what age will they die**? How much **life** can they expect to **lose**?

Lord Marshall's model for the mortality period – the time between the induction of a radiation cancer and death

- Lord Marshall's model, discussed and approved by cancer epidemiologist, Sir Richard Doll, assumed that a non-acute radiation dose could lead to death from a radiation cancer between **10 and 40 years** after exposure to the dose.
- In 2005 Richardson and Ashmore confirmed the parameters of this model (without reference to Marshall) in their study of **40,000 Canadian radiation workers**.

Marshall's uniform probability density for the period to death at age, *y*, from a fatal radiation cancer induced at age, *x*

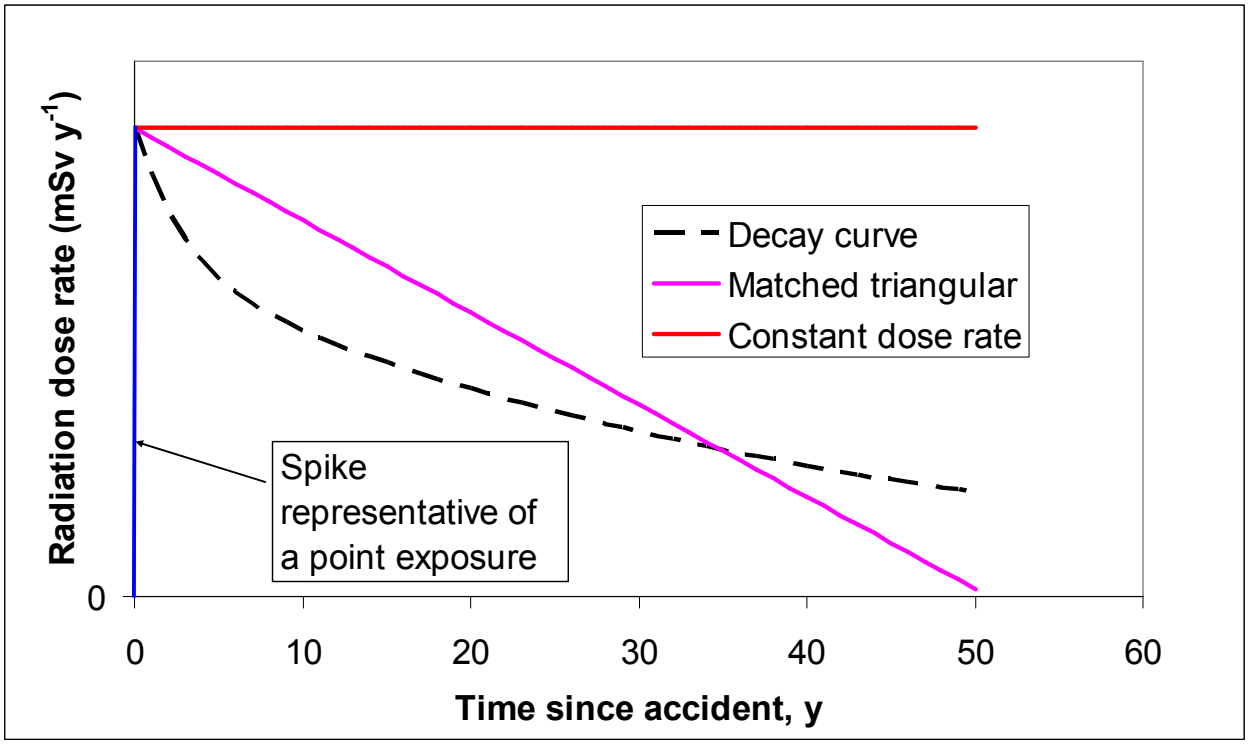


Sensitivity studies: (i): ω_1 = 5 years
(ii): ω_2 = 45 years

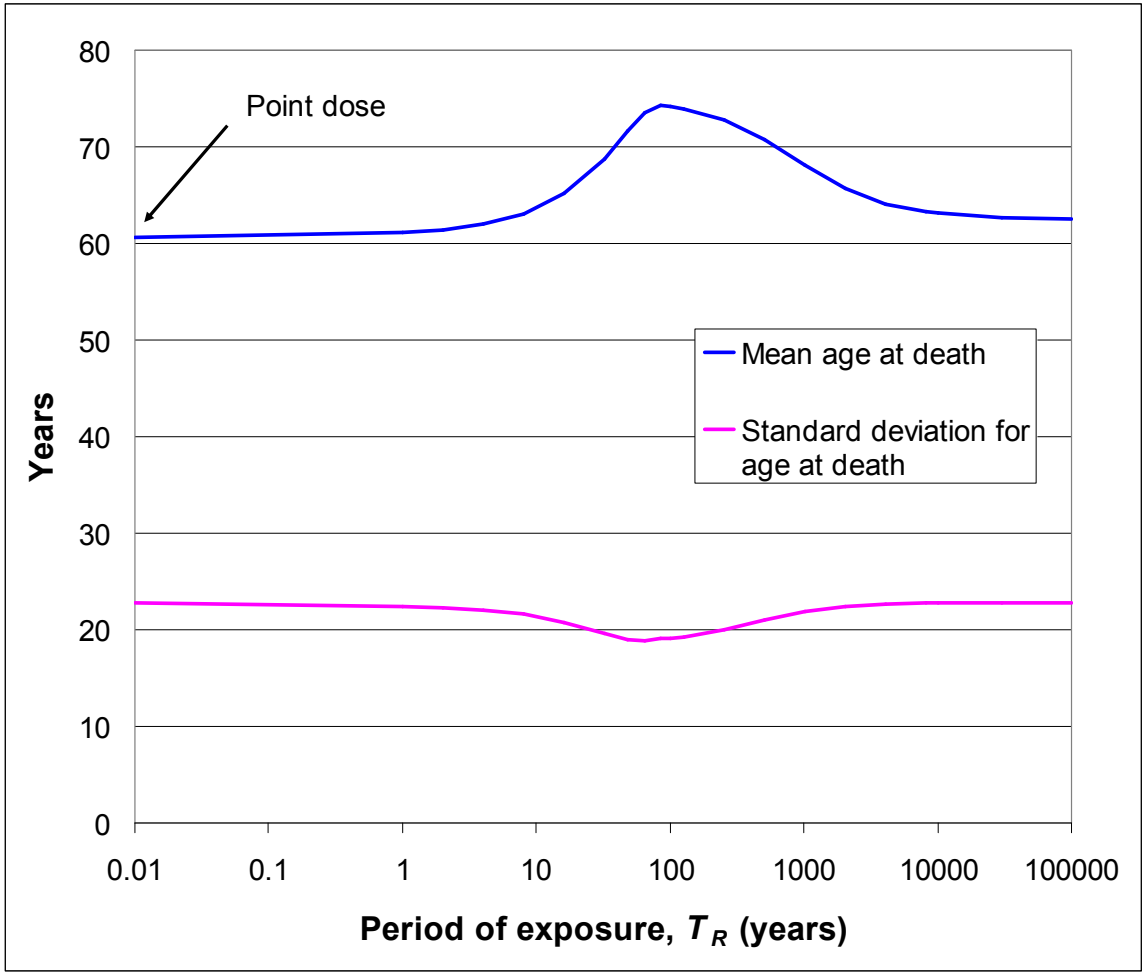
Order of magnitude calculation

- The average age of people in the UK is about 41 and the average mortality period from the Marshall model is (10+40)/2 = 25 years.
- So intuitively we might think that the average age at death will be about 41 + 25 = 66 years.
- This is not rigorous (even for a point exposure) and the maths are actually very much more complicated, but this gives a first, rough guide.

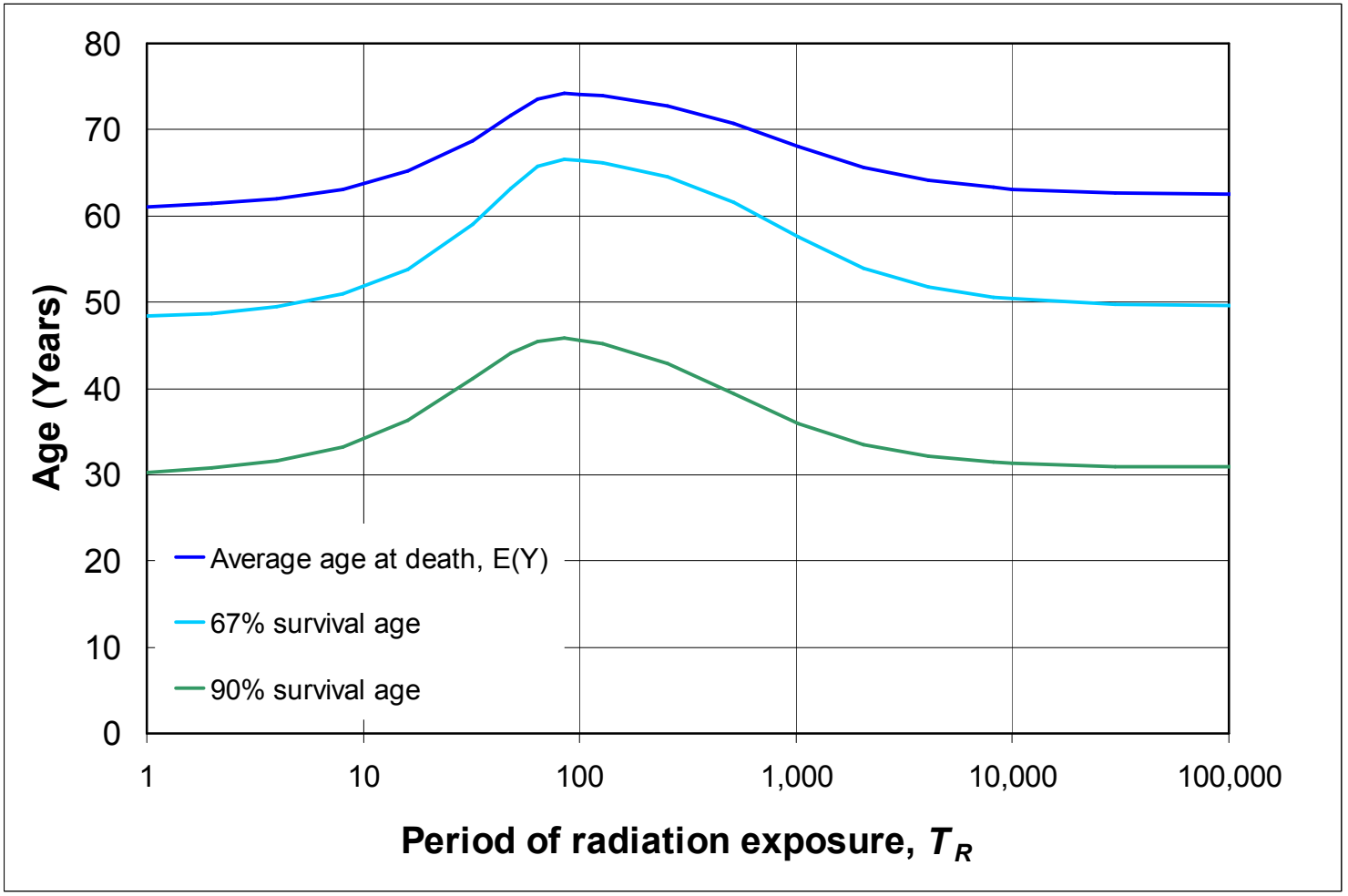
Two representative radiation profiles tested: a point exposure and a constant dose over a time period that can be varied



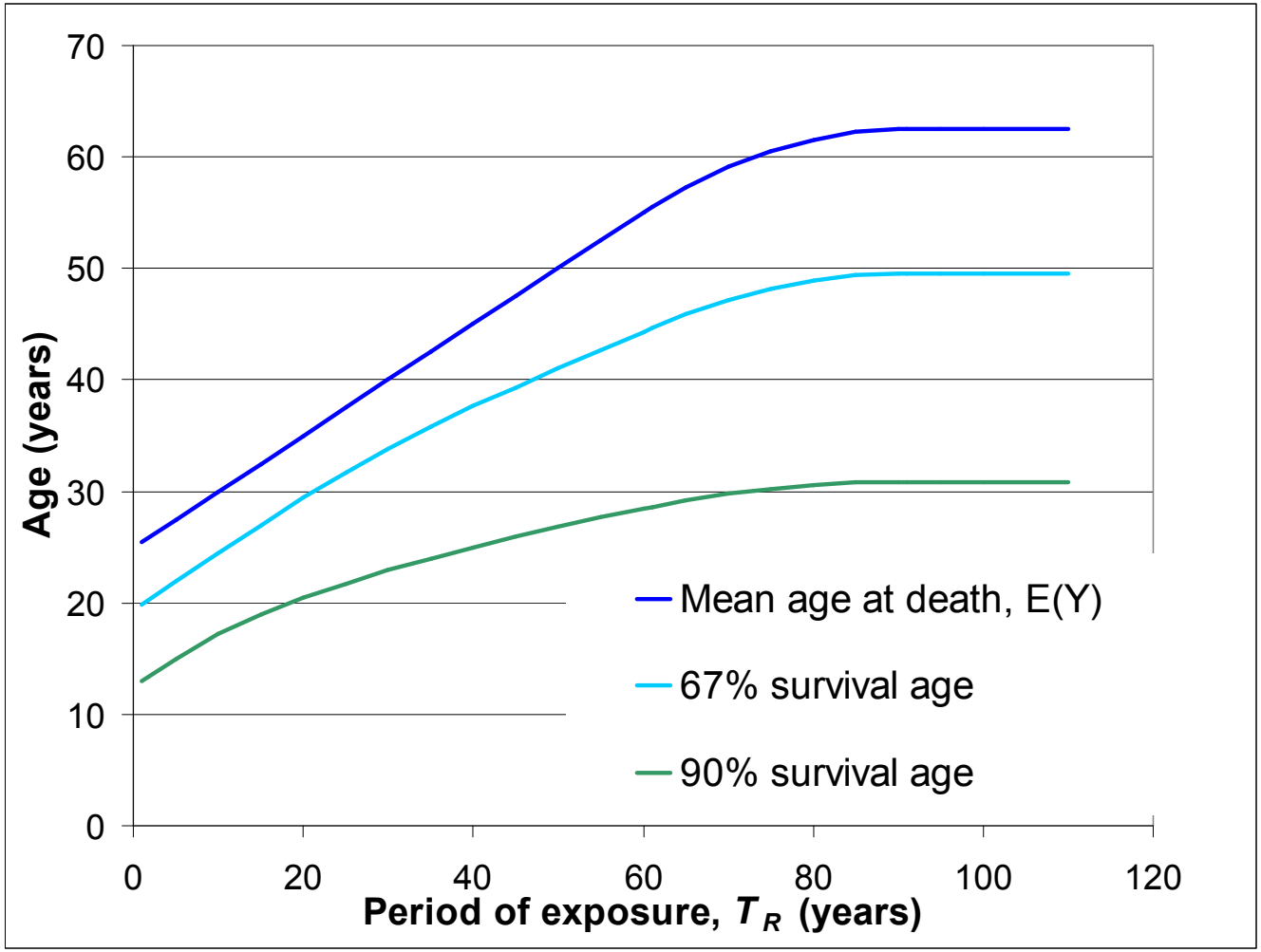
Results of the analysis: Mean age at death and standard deviation



Probability bands
2-1 (on) and
9-1 (on) odds of living longer

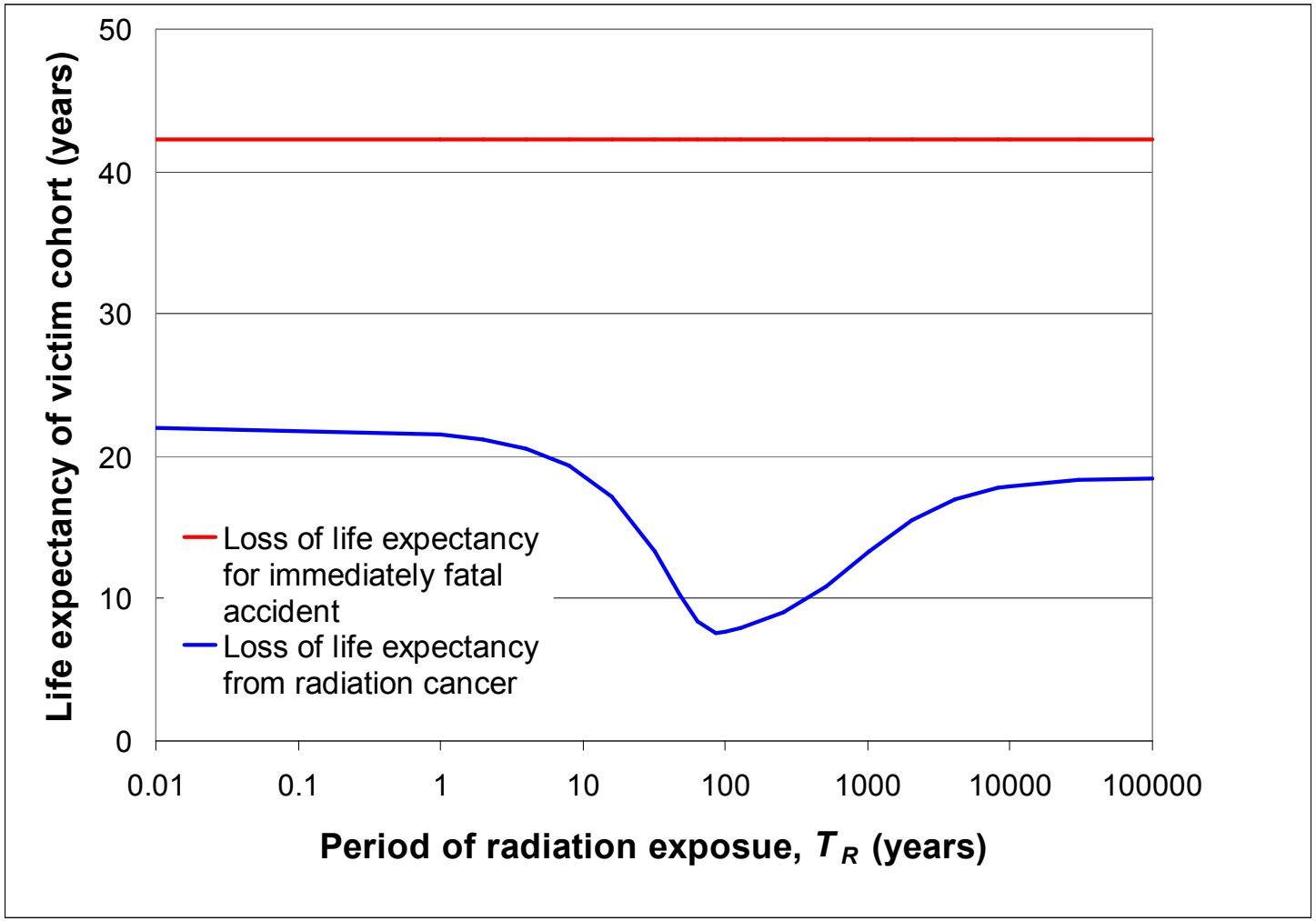


When exposure to radiation starts at birth
2-1 (on) and
9-1 (on) odds of living longer.



Loss of life expectancy

Comparing the loss of life expectancy from an immediately fatal accident with the loss due to a radiation cancer



Features of the analysis

- The results apply to non-acute radiation doses (where radiation sickness does not occur).
- Within that region
  - the size of **radiation risk coefficient** does **not matter**, so the results will not change if the ICRP revises its figures
  - the **size of the non-acute dose** or dose rate does **not matter**.

Conclusions

- The average radiation cancer victim will **live into his or her 60s or 70s**.
- The **average loss of life expectancy** amongst radiation cancer victims will be between **8 and 22 years**.
- On average, the **radiation cancer victim** will lose **half or less than half** the life expectancy he or she would lose in a **fatal rail crash or car crash**.
- The **value of a prevented fatality (VPF)** used widely in cost benefit analyses in the UK is a **poor measure** of what could be lost in a radiation accident and is **unsuitable for use in nuclear safety assessments**.