P142: Interpretation of radiation risks from low dose diagnostic scans

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Introduction

- There is disagreement over how to interpret risks from low dose radiation exposures.
- Advice on how to manage risk varies in substance or emphasis.
- For example some place emphasis on the number of cancers that x-rays may cause, others claim risks with the low doses are highly speculative [1-5].
- This paper divides uncertainty over risks into two distinct categories and analyses a range of claims about low dose radiation risk taking account of this categorisation.

Methods

1. We observe that the uncertainty about low dose radiation risks may be divided into two distinct categories
2. The first category relates to statements of fact and resolve as true, untrue or unknown. The second category relates to measurement uncertainty and resolves as an error bar.
3. We take three statements that cross a range of possible claims about the effects of low dose radiation risk
4. We identify the statements or premises needed to support these claims
5. We revaluate the claims taking account of the category of uncertainty that applies to each supporting statement.

Results

- The results of the analysis are shown in Fig 1 & Fig 2

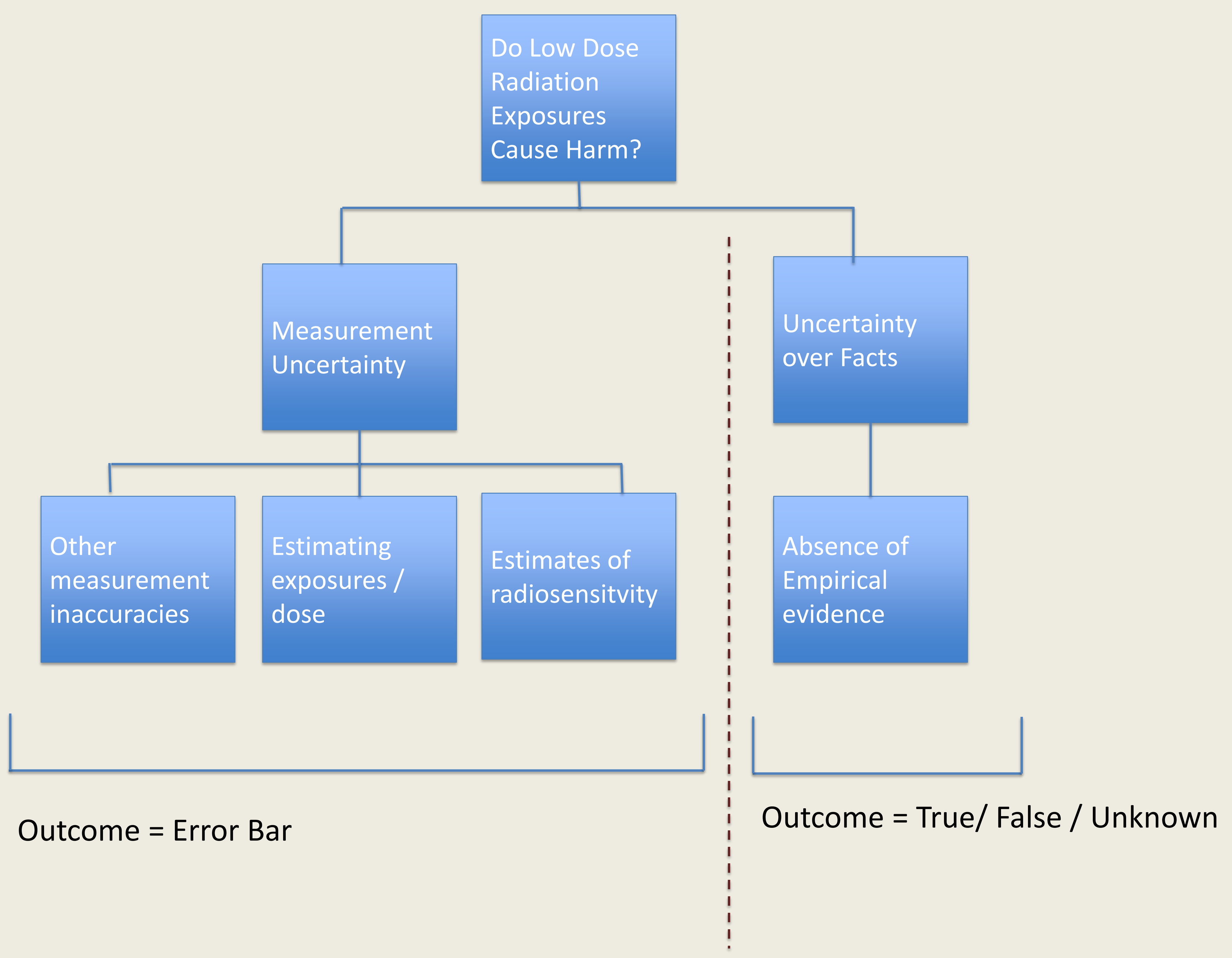

Fig 1: Dividing factors affecting uncertainty over risk into two distinct categories.

Discussion (1) Justification for categorisation

Two types of uncertainty are identified:

- The first is to do with estimating exposures and radiosensitivities; these parameters vary across equipment and populations – this type of variation adds to uncertainty in predicting whether an individual may be harmed as a consequence of radiation exposure, but does not in itself create uncertainty over whether there is an effect at all. The outcome of this type of uncertainty is an error bar.
- The second type of uncertainty is to do with the basis for assuming this risk – harmful effects cannot be definitively shown from empirical evidence; risk is based on a simple model (linear extrapolation from evidence of effects in a population at higher doses).
- These types of uncertainty may be placed into different categories because the outcome, or what we may infer taking account of these types of risks, differs. For measurement errors the result of uncertainty is an error bar; in contrast, statements about fact are either True or False (and whether it is true or false may be unknown).

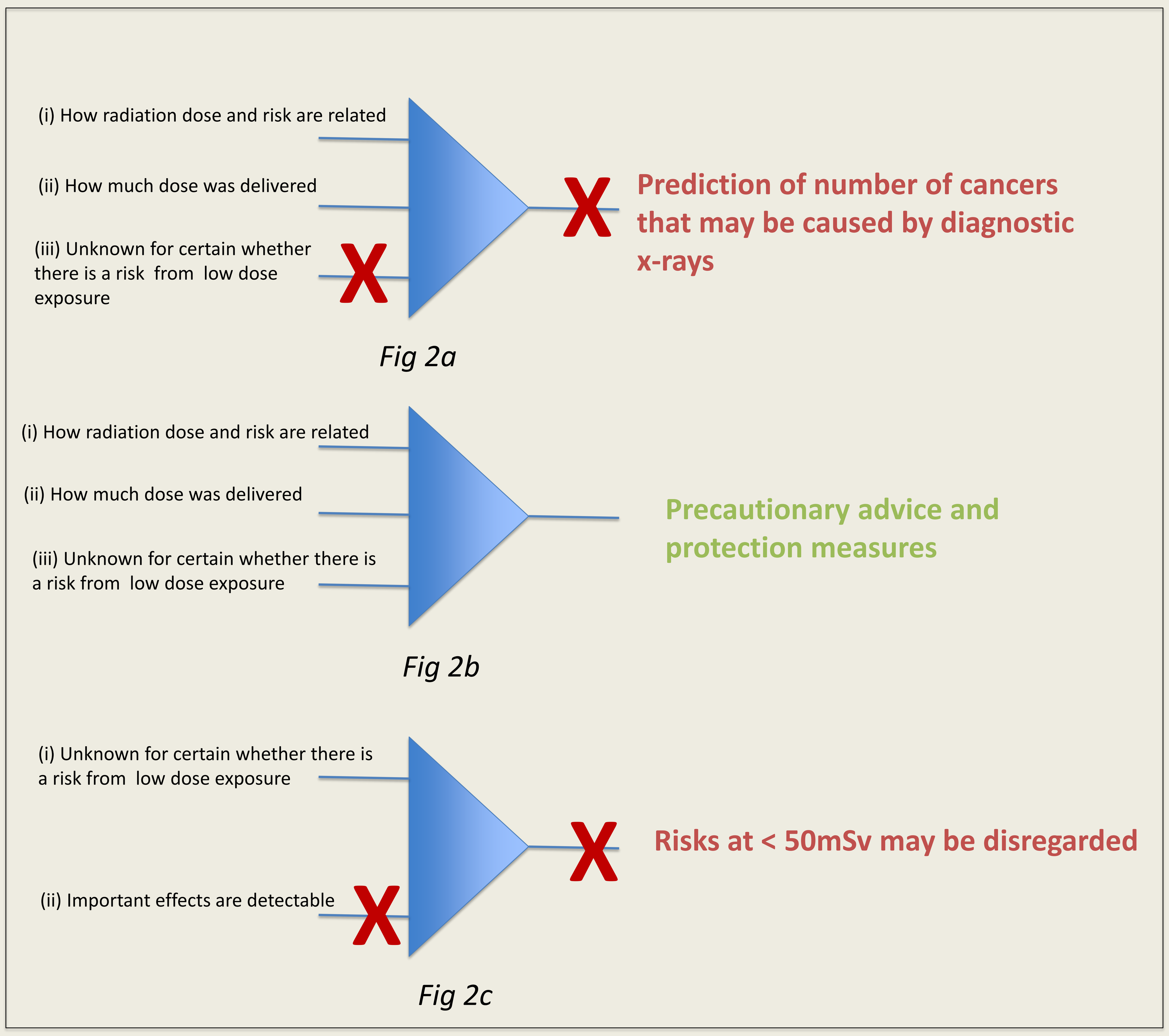

Fig 2: The range of claims that may be made about risk are shown as outputs. The inputs identify key statements needed to support each claim. In Figs 2a and 2b, Inputs (i) and (ii) relate to measurements and Input (iii) relates to Fact which can be True, False or Unknown. In Fig 2c both inputs (i) and (ii) relate to facts. Input (ii) is False. The 'X' at the input side indicates the statement or premise which invalidates the claim

Discussion (2) Explanation of each argument

- Fig 2a-2c depict a range of claims that may be made about low dose risk. While 2a and 2c are rarely explicitly claimed, claims which are close to these positions can be made [1-5].
- From 2a, to predict the number of cancers that may be caused by diagnostic x-rays we would need to (i) know the relationship between dose and risk, (ii) to make a measurement of dose, and (iii) know that the relationship holds for the doses for which we are making the prediction. Input (i) depends on radio-sensitivity and the harm radiation may cause and Input (ii) on measurement of dose. Both (i) and (ii) are subject to measurement inaccuracies, but if these were the only limitations then prediction of number of cancers could be made, with the measurement inaccuracy determining the error bar. Criticism of use of Effective Dose to support risk estimates which relies on the inaccuracies underpinning its calculation do not take sufficient note of this point. However, input (iii) relates to uncertainty over a matter of fact: on the current state of knowledge there is insufficient evidence to say whether it is True or False. It is not measurement uncertainty, but the uncertainty over true/false value of Input (iii) that prevents predictions being made.
- If our objective is advice on risk (Fig 2b) we can take a prudential approach and assume Input (iii) is true. Hence we can use our measurements for "RP purposes only." Thus unknown value for Input (iii) in Fig 2a and 2b prevents prediction, but not the making prudential judgments.
- Fig 2c takes its being unknown whether there is a risk as a starting point. It is easy to suppose that if science cannot detect a risk, then that risk must be negligible: however, this ignores the fact that because cancer is a common disease, x-rays would have to cause large numbers of cancers before the risk could be detected. In this context, unmeasurable, low probability risk cannot be equated with inconsequential risk.

Conclusions

- Dividing the types of uncertainty relating to risk from low dose radiation exposures into the two distinct categories clarifies interpretation of risk.
- This poster sets out categories of risk and makes explicit the types of uncertainty that limit the predictive power of low dose risk estimates.

References

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