

Quantification of probability that death certificate misclassification increases measures of risk in epidemiology



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Introduction

The causes of death on death certificates are widely used as a primary source of the health outcome information in epidemiological studies that evaluate dose-response associations. However, the autopsy report is considered the gold standard for determining underlying causes of death. In our previous research, health outcome discrepancies were observed between the underlying causes of death listed on death certificates and those on autopsy reports¹. In epidemiology studies, the general consensus is that death certificate misclassification is more likely to reduce measures of risk, for example the odds ratio, than to increase it. In an effort to better understand how such misclassifications affect health outcome assessments and research conclusions, the study aimed to quantify the misclassification impact by evaluating the percentage of odds ratios increase.

Radiation Dose Data

- 5,122 cumulative colon dose records were extracted from a cohort of Rocky Flats workers

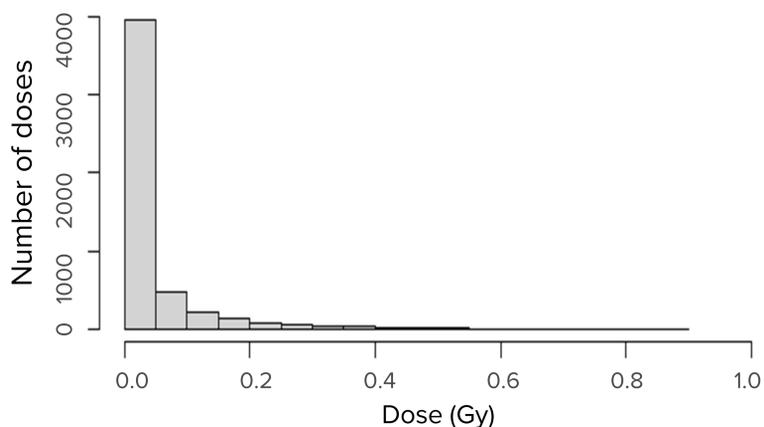


Figure 1: Histogram of total cumulative colon doses from Rocky Flats cohort

Cancer Outcome Generation

- Logistic function was used to calculate the probability of cancer outcome $p(x)$ for each dose record:

$$p(x) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 x)}}$$

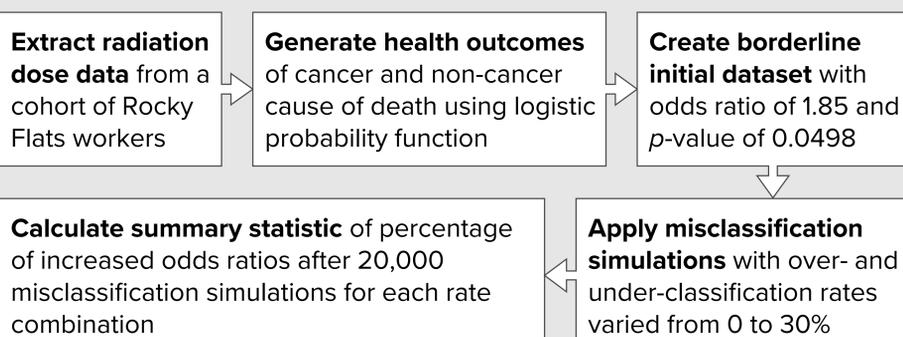
x : Dose values (Gy)

β_0 : Constant derived from a baseline cancer incidence of 26%

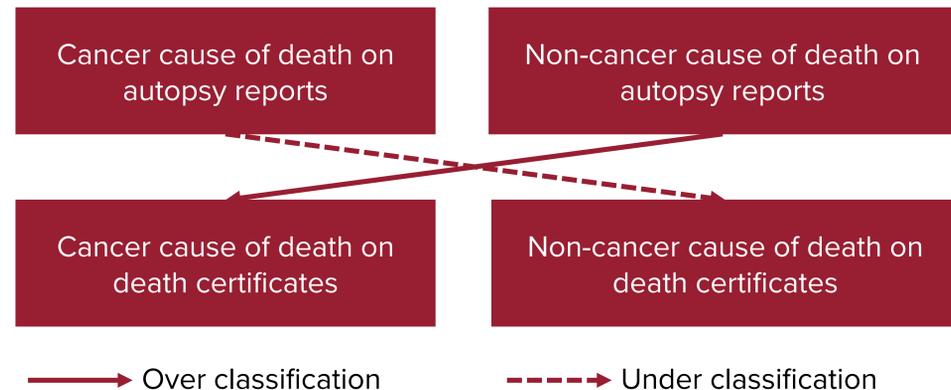
β_1 : Logarithm of the predetermined initial odds ratio

- Cancer outcomes were randomly generated for each dose record using $p(x)$
- 1,000 repetitions of the outcome generation process were conducted to select an initial scenario for the misclassification simulation (a borderline scenario with p-value just below the significance threshold)

Overview of Method Workflow



Misclassification Simulation



$$\text{Over classification rate} = \frac{\text{Number of False Positives}}{\text{Total Number of Noncancer on ARs}}$$

$$\text{Under classification rate} = \frac{\text{Number of False Negatives}}{\text{Total Number of Cancer on ARs}}$$

Misclassification Rates Impact on Increased Odds Ratios

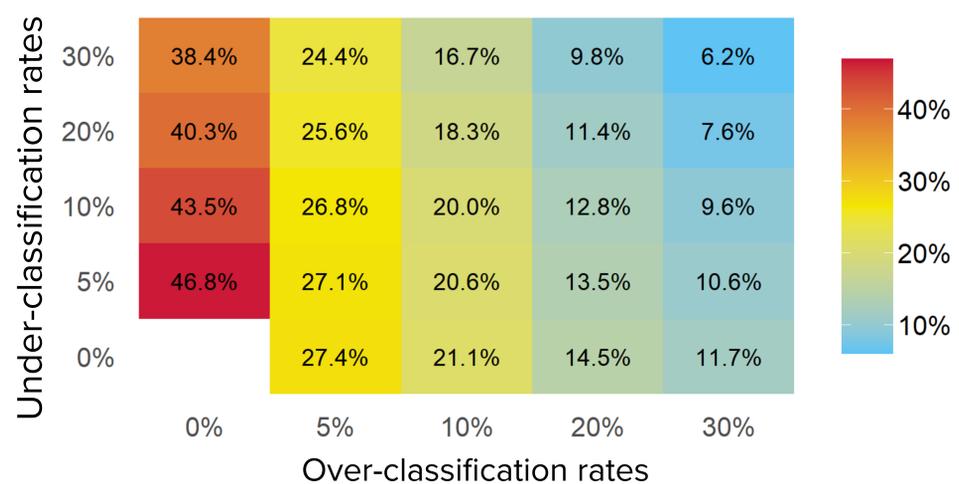


Figure 3: How different over- and under-classification rates impact on percentage of increased odds ratio after 20,000 times simulations

Conclusions

- While the general consensus that death certificate misclassification is more likely to reduce risk estimates is correct, this study demonstrated that the likelihood of increased risk estimates can be substantial.
- Lower misclassification rates led to a more substantial impact on the conclusion about health risks.
- Over- and under-classification effects tended to cancel each other out at higher misclassification rates.

Discussion

- While the exact percentages may vary under different assumptions, this study underscores the importance of considering the impact of death certificate misclassifications in epidemiological analyses, as the effects are more complex than generally anticipated.
- Future research will continue to explore the complex relationship between disease misclassifications and study conclusions and will simulate more representative data by altering key parameters.

Reference

- McComish, Stacey L et al. "Misclassification of causes of death among a small all-autopsied group of former nuclear workers: Death certificates vs. autopsy reports." PLoS one vol. 19,5 e0302069. 3 May. 2024, doi:10.1371/journal.pone.0302069