Relation of Probability and Causation to Relative Risk and Doubling Dose

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According to Egilman et al. [1] court decisions refer to a "doubling of the risk" to quantify the causal relationship between exposure and disease in an individual. When courts use this term "doubling of the risk", they are often speaking of the risk fraction (*RF*) which is defined as

$$RF(d) = \frac{RR(d) - 1}{RR(d)} \quad ,$$

where *d* stands for dose and *RR*(*d*) for the relative risk comparing exposed and unexposed populations depending on dose *d*. The *RF* may be used as a proxy to the probability of causation (*PC*). This probability is nothing what we can observe, although we have to derive it from observational studies. What we need is a theoretical construct.
Under relatively simple, realistic, and understandable conditions we show that in case of a rare disease the *RF* for an infinitesimal small time window is exactly the *PC*. Hence, it seems justified to consider $\frac{RR-1}{RR}$ as a universal measure for *PC* if the relative risk model holds true and the disease is rare.
This model, for which *RF* = *PC* can be shown, is one of an infinitude of models discussed by Robins and Greenland [2, 3]. Most of the models do not have the characteristic *RF* = *PC*. Our approach demonstrates that relatively simple, realistic, and understandable conditions give a model with *RF* = *PC*. However, in general, the unreflecting use of the risk fraction as a surrogate for the probability of causation may give misleading results.

Literatur

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