

hazard example

2024-01-30

Assessment question

For this hazard identification the question is if exposure to compound X can cause an effect in a chosen endpoint? This is a categorical questions with two possible answers NO and YES.

Practical certainty

The practical certainty is by risk managers set to be 66% probability for a YES and 80% probability for a NO. The assessment is *inconclusive* for any uncertainty in between the limits.

A tiered approach with uncertainty expressed by a precise probability

Step 1.1

Evidence is a QSAR with known sensitivity (TPR=80%) and specificity (TNR=70%) with a negative prediction for the endpoint.

Sensitivity (true positive rate) is the probability of a positive test result, conditioned on the individual truly being positive.

Specificity (true negative rate) is the probability of a negative test result, conditioned on the individual truly being negative.

We (the assessors) apply Bayesian reasoning with a prior probability of 50% (*As likely as not*) that the answer is YES to the assessment question.

Given the evidence, the we are 22% certain that X is an hazard.

This is the same thing as saying that we are 78% certain that the answer is NO.

Is practical certainty reached?

No.

We proceed by **reducing** uncertainty by collecting more information.

Step 1.2

Evidence now consists of two more QSARs with known sensitivities and specificities

TPR	TNR	Prediction
80%	70%	negative
75%	90%	negative
50%	70%	positive

We (the assessors) apply Bayesian reasoning with a prior probability of 50% that the answer is YES to the assessment question.

The probability of YES given the evidence is 12%

This is the same thing as the probability of NO given the evidence is 88%

Is practical certainty reached?

Yes.

Conclusion 1

There is sufficient certainty that X is not a hazard. Proceed with the decision.

A tiered approach with uncertainty expressed by a bounded probability

Step 2.1

Same as above, but start with a prior for a YES bounded in the range of inconclusiveness i.e. between 20 and 66% probability.

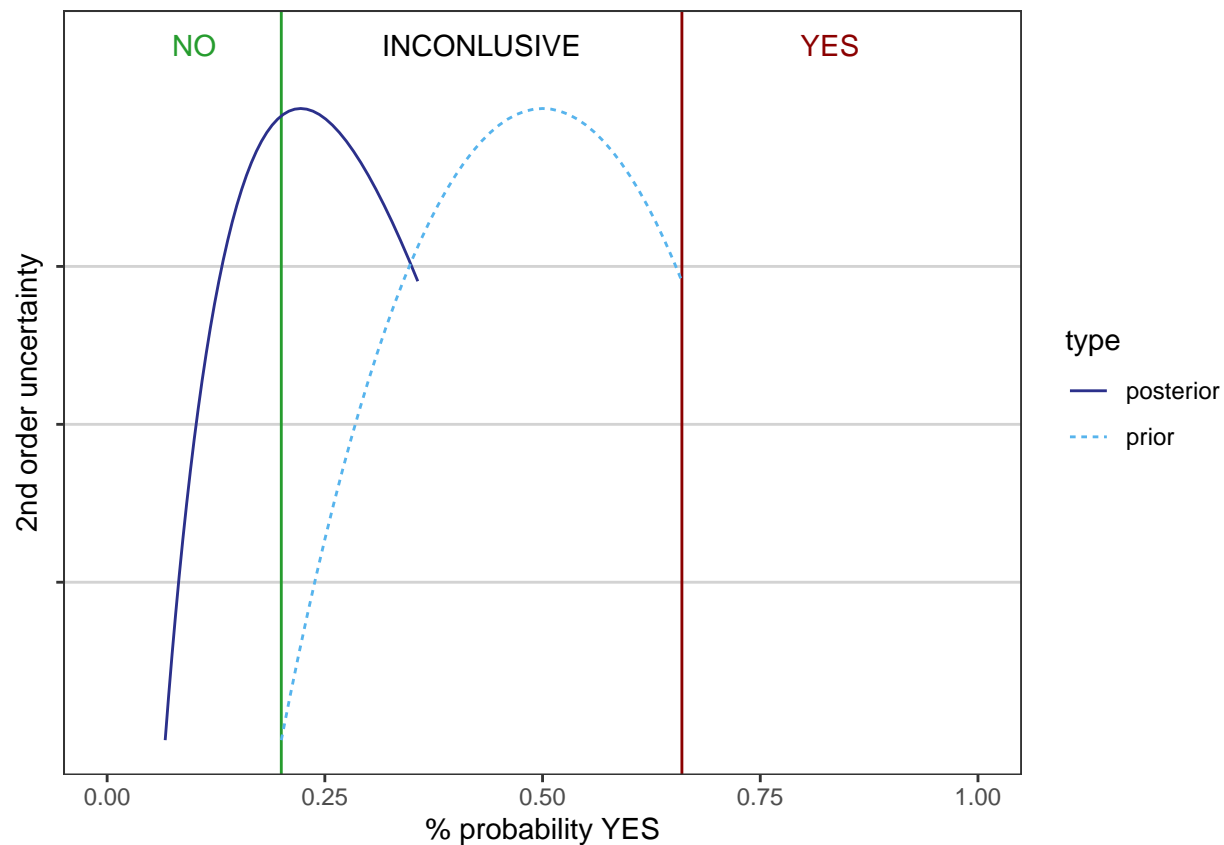
The probability of YES given the evidence is between 7 and 36%.

Is practical certainty reached?

No.

The prior probability must be less than 46% instead of less than 66% for the conclusion to reach practical certainty.

A way to illustrate this is to use an unit-less measure for second order uncertainty (or robustness) that maps the prior to the posterior.



Let us proceed by **reducing** uncertainty by collecting more information.

Step 2.2

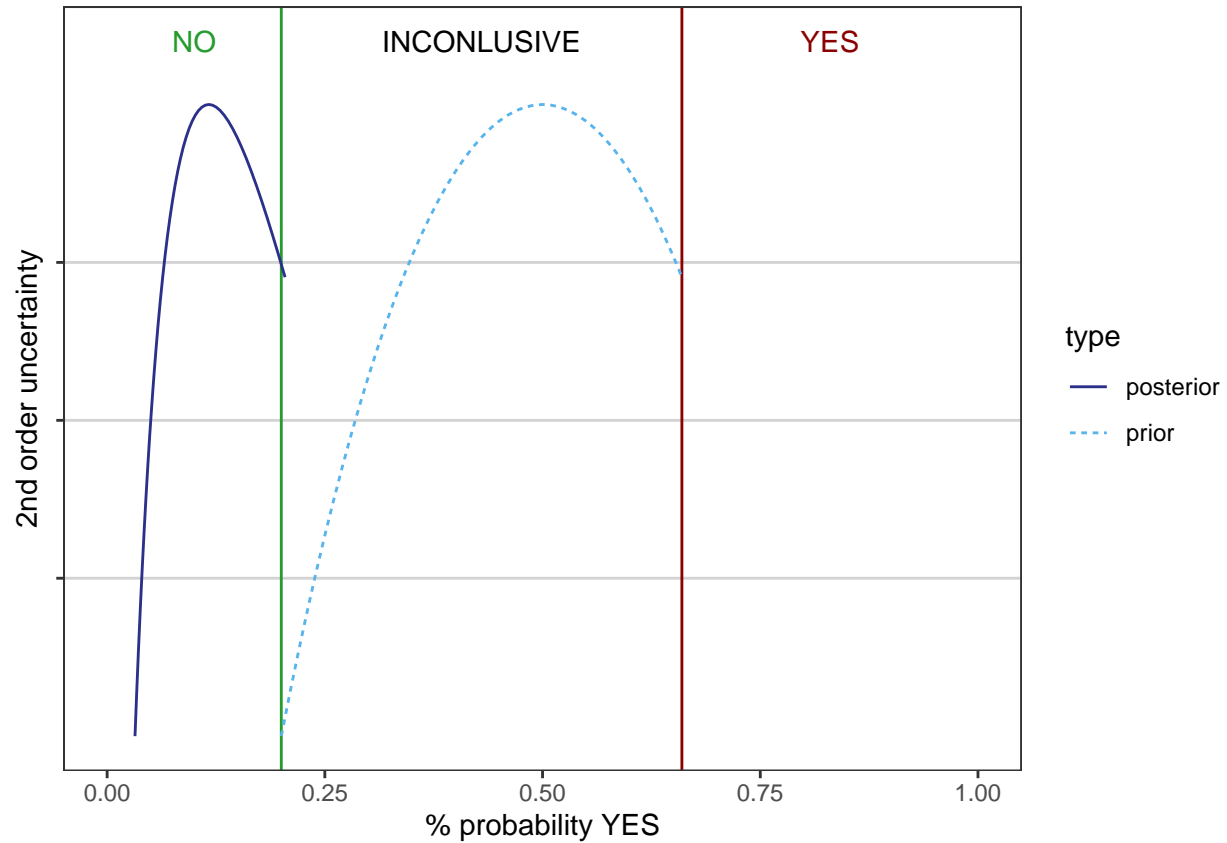
Same as above for step 2 with three QSARs.

The probability of YES given the evidence is between 7 and 36%.

Is practical certainty reached?

No, but it is close.

The prior probability for a YES must be less than 65% instead of less than 66% for the conclusion to reach practical certainty.



Let us proceed by **refining** the characterisation of uncertainty.

Step 2.3

The assessors agree that prior for a YES could have been less than 60% probability.

This implies that practical certainty is reached.

Risk managers agree that the conclusion is NO with sufficient certainty.

Conclusion 2

There is sufficient certainty that X is not a hazard. Proceed with the decision.

A tiered approach with uncertainty analysis done using DST