The risk-based price

incorporating uncertainty and risk attitudes in health technology pricing

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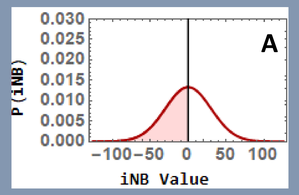
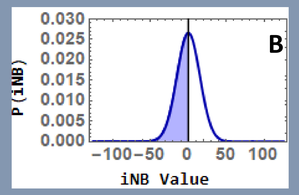
BACKGROUND. Decision-makers often use value-based decision rules to determine if technologies offer good value for money and should therefore be adopted, comparing cost-effectiveness analysis results to a threshold value. This assumes that decision-makers are indifferent between interventions with the same expected value but different levels of underlying uncertainty.

For example, consider the net benefit distributions for two technologies which treat the same condition below. Risk-averse decision makers will prefer technology A, while risk-seeking decision makers will prefer technology B. Risk-neutral decision makers are indifferent between the two, with is the risk attitude reflected by standard decision rules. Such indifference may not hold in practice.





OBJECTIVE. We propose the risk-based price and associated decision rules to incorporate risk attitudes in decision making.

METHODS. Risk is measured using a novel value-of-information output called the **independent expected value of perfect information** (iEVPI). The iEVPI estimates the expected value of net benefit losses caused by uncertainty related to a technology, independent of the uncertainty related to alternative treatments. **Payer risk tolerance** is then defined as the maximum per-patient risk of making wrong decisions that payers are willing to accept, expressed in monetary terms. **The risk-based price is the price at which the iEVPI is equal to the payer risk tolerance.**

Risk-Based Decision Rules

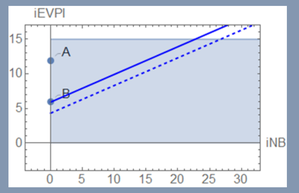
(i) a technology is acceptable for adoption if the incremental net benefit of the technology is greater than or equal to zero, and if the iEVPI is less than or equal to the payer risk tolerance, and

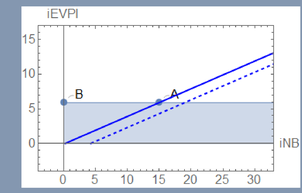
(ii) the optimal technology has the greatest expected net benefit at the lowest of the sponsor submitted, value-based, or risk-based price at a given cost-effectiveness threshold value.

CONCLUSIONS. We demonstrate that both risk-averse and risk-neutral payers prefer the outcomes of risk-based pricing. We show that risk-based decision rules improve sponsor incentives for on-market, real-world evidence development, and that implementation of the risk-based price improves outcomes for patients by increasing health system net benefits under constrained resources with better alignment to decision-maker risk attitudes.

Example: decision rules in action

Suppose there are two technologies, with the same expected net benefit but different underlying uncertainty, as in the density functions to the left.





The risk-benefit planes above indicate the iEVPI and the iNB for each technology. The blue shaded area indicates the acceptable decision space, where iEPVI is strictly greater than zero and less than the payer risk tolerance, and the iNB is positive. On the left, the payer risk tolerance value is greater than the iEVPI for both technologies, so both are acceptable and optimal under risk-based decision rules. On the right, the payer risk tolerance is less than the iEPVI for technology A at value-based pricing (see left pane), so the price of A must be reduced so that the iEVPI is equal to the payer risk tolerance. In this case, both A and B are acceptable, but A is optimal with the greatest iNB.