

Eliciting beliefs to inform parameters within a decision analytic model

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Uncertainty in decision modelling

- Uncertainty is pervasive in any assessment of cost-effectiveness.
- Decision analysis is a systematic and quantitative approach to decision making under conditions of uncertainty.
- Models need to provide an estimate of the associated decision uncertainty.
- Is current evidence is a sufficient basis for an adoption decision.
- There are a number of sources of uncertainty.
 - Parameter
 - Methodological
 - Structural

Characterising structural uncertainties

- Methods to characterise parameter uncertainty are well rehearsed.
- Many issues of methodological uncertainty have been resolved by harmonisation of techniques.
- Structural uncertainty has received little attention.
- Structural uncertainty refers to the simplifications and scientific judgments that are made when constructing and interpreting a model.
- Characterising these uncertainties limited to scenarios.
- Model selection not possible for many uncertainties.
- Model averaging is possible.
- Need to quantify the value of further research to resolve structural uncertainty (EVPI methods).

Parameterising structural uncertainties

- The assumptions that distinguish different models or scenarios can be thought of as missing parameters.
- Include additional ‘uncertain’ parameters.
- Sources of structural uncertainty can be represented directly in the model.
- Calculate value of additional research to resolve uncertainty.
- Uncertain parameters can be specified using a number of different distributions, depending on what prior information is available.
- Probability weights should represent the beliefs of experts or decision makers – expert elicitation.

What is expert elicitation?

- An elicitation method is intended to link an experts beliefs to an expression of these in a statistical form.
- Elicitation techniques used in Bayesian statistics because of the need to formulate subjective probabilities.
- Expert elicitation can also be used in decision analysis to quantify unknown parameters in the absence of actual data.
- Decision analysis has typically employed less formal elicitation techniques (consulting experts for 'best guess').

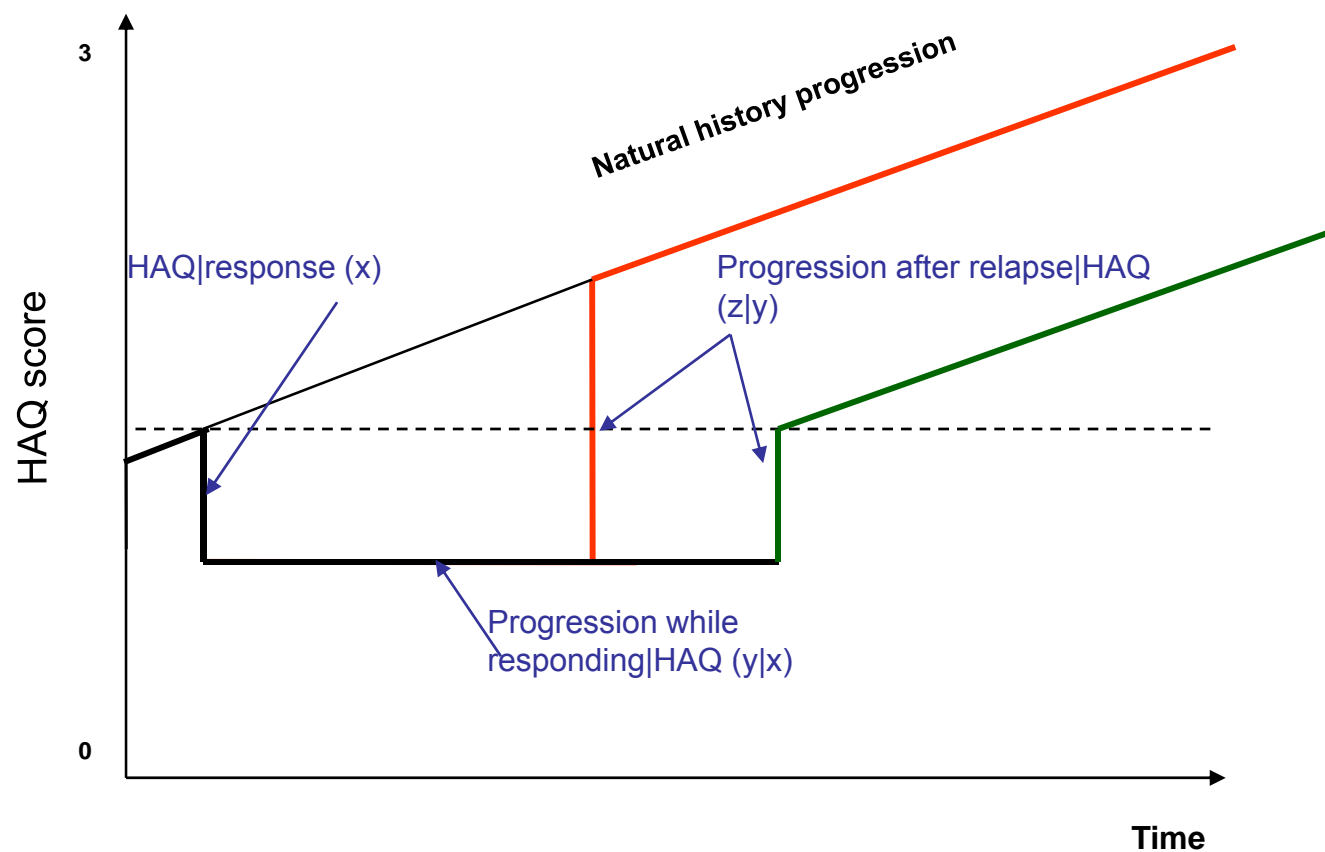
Eliciting experts priors

- No standard protocols for the conduct of elicitation assessments.
- Much is context specific, but there are a number of issues to consider, including:
 - General approach to elicitation (behavioural or mathematical)
 - Who to elicit from
 - What quantities to elicit
 - Elicitation method (interval method, histograms)
 - Synthesis approach
 - Assessing adequacy

An example: Psoriatic arthritis (PsA)

- Methods to elicit parameters for a DAM illustrated with a case study.
- Case study:
 - Probabilistic cost-effectiveness analysis of anti-TNF drugs for the treatment of active PsA
 - Compares etanercept, infliximab, palliative care
 - EVPI and EVPPI to inform research priorities
 - Some key structural assumptions made

Alternative structural assumptions



- Rebound equal to gain
 - Rebound to natural history progression
- Assumption: biologics halt progression

Scenario results for NICE model

Strategy	ICER	P(c/e)	EVPI
Rebound equal to gain			
Infliximab	£165,363	0.001	£23mil
Etanercept	£26,361	0.693	
Palliative care	-	0.306	
Rebound equal to natural history			
Infliximab	£205,345	0.000	£34mil
Etanercept	£30,628	0.446	
Palliative care	-	0.554	

- Value was associated with utility and effectiveness parameters.
- Could not determine the value of uncertainty regarding rebound effect.

Parameters required

- HAQ gain given response (x)
 - Estimated from RCT evidence
- Two unknown model parameters:
 - Progression whilst responding (y)
 - Progression after relapse (z)
- These parameters may also be correlated
 - Require estimates of
 - Progression while responding given HAQ gain ($y|x$)
 - Progression after relapse conditional on progression while responding ($z|y$)

Elicitation methods

- Interactive Excel based elicitation questionnaire.
- Distributions elicited using histograms
- Elicit the known parameter (x)
 - Used to calibrate (weight) experts for synthesis.
- Elicit $y|x$ for 4 ranges of x (percentiles)
 - From the RCT estimates of HAQ gain
- Elicit $z|y$ for 4 ranges of y
 - Generated by sampling from responses to $y|x$ and x

Example question

Question 1: Initial gain in HAQ score following treatment with etanercept or infliximab

HAQ score can change following treatment with etanercept or infliximab. It is generally accepted that following treatment, HAQ score will decrease (a HAQ gain), however we are unsure about the magnitude of HAQ gain with etanercept or infliximab

Question 1a: What would you expect the HAQ score to be for patients who have received etanercept? (remember the baseline score without treatment is 1.16)


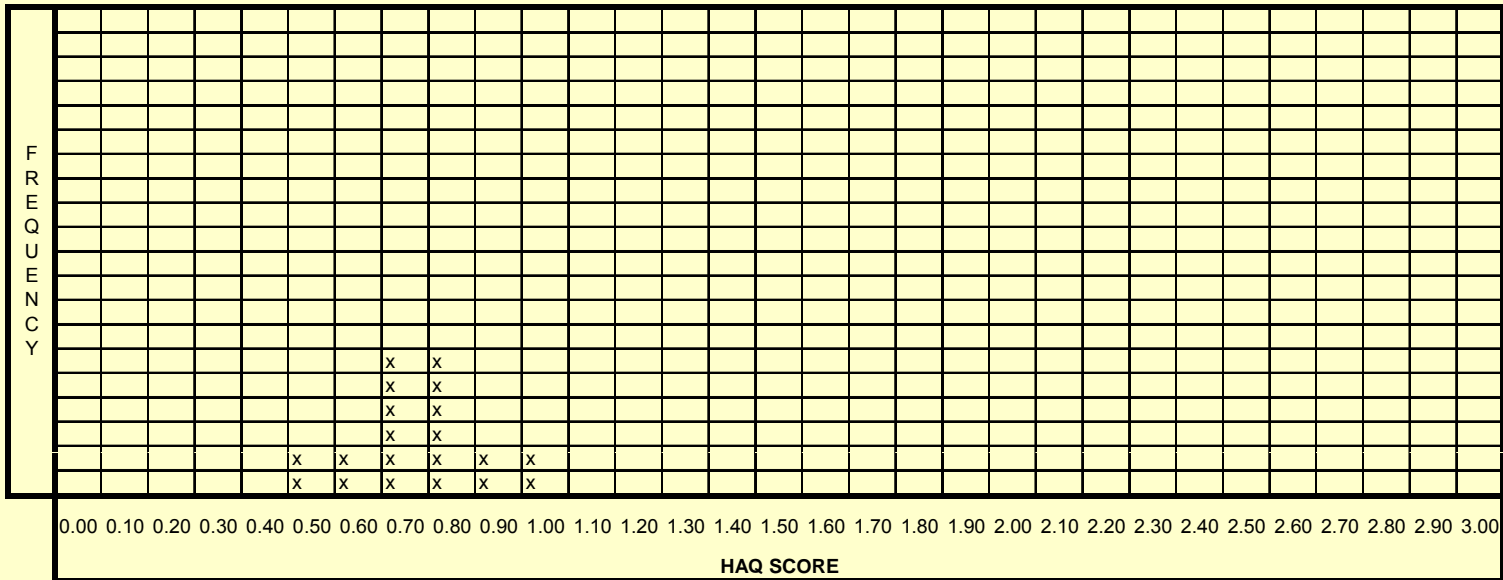
x	x	x	x	x	x	x	x	x	x	x
x	x	x	x	x	x	x	x	x	x	x

Please drag and drop the crosses into the grid or simply type crosses into the grid

To clear your response to this question and start again press →

Clear

Left click arrow to scroll down to next question

Synthesis of elicited priors

- Scenario for each individual expert
 - Implicit judgement still required
- Linear pooling
 - Experts form an overall distribution
 - More experts do not add to precision
 - Not weighted by precision
- Calibration
 - Accuracy of responses to known parameters used to weight experts.
 - Uncertain experts not penalised

Responses to elicitation questionnaire

Expert No	HAQ gain (x)		Progression while responding (y)		Progression after relapse (z)	
	E	I	E	I	E	I
1	-0.64 (0.15)	-0.83 (0.14)	0.016 (0.008)	0.019 (0.009)	0.069 (0.009)	0.047 (0.032)
2	-0.78 (0.08)	-0.78 (0.08)	0.053 (0.046)	0.057 (0.046)	0.106 (0.037)	0.053 (0.037)
3	-0.87 (0.16)	-0.88 (0.16)	0.04 (0.008)	0.036 (0.009)	0.064 (0.006)	0.049 (0.028)
4	-1.17 (0.13)	-1.26 (0.13)	0.007 (0.004)	0.009 (0.006)	0.065 (0.009)	0.036 (0.038)
5	-1.01 (0.20)	-1.01 (0.20)	0.014 (0.010)	0.014 (0.011)	0.06	0.06
Known	-0.632 (0.06)	-0.579 (0.09)	-	-	-	-

Results for individual experts

Expert No	Strategy	Cost	QALY	ICER	P(c/e)	EVPI
1	Infliximab	£64,383	4.466	D	0.036	£313 mil
	Etanercept	£44,048	4.492	£27,041	0.596	
	Palliative	£10,685	3.258	-	0.368	
2	Infliximab	£65,222	3.350	D	0.109	£745 mil
	Etanercept	£44,824	3.478	£154,790	0.211	
	Palliative	£10,658	3.258	-	0.68	
3	Infliximab	£64,121	4.858	£137,769	0.099	£220 mil
	Etanercept	£43,947	4.712	£23,168	0.731	
	Palliative	£10,701	3.277	-	0.17	
4	Infliximab	£64,576	5.047	£141,789	0.027	£20 mil
	Etanercept	£44,408	4.905	£20,085	0.936	
	Palliative	£11,114	3.247	-	0.037	
5	Infliximab	£63,891	5.015	£136,352	0.043	£34 mil
	Etanercept	£43,835	4.868	£20,491	0.899	
	Palliative	£10,709	3.252	-	0.058	

Calibration (weighting) of experts

Expert	Weight	
	Etanercept	Infliximab
1	0.7032	0.0728
2	0.2042	0.6016
3	0.0703	0.3099
4	0.0022	0.0005
5	0.0202	0.0153

Synthesis results

	Progression whilst responding (y x)		Progression after relapse (z y)	
	Etanercept	Infliximab	Etanercept	Infliximab
Linear pooling	0.024 (0.009)	0.022 (0.008)	0.054 (0.010)	0.067 (0.007)
Weighted Linear pooling	0.023 (0.013)	0.047 (0.028)	0.040 (0.010)	0.076 (0.018)

- y and x are negatively correlated – slower HAQ gain = slower progression
- z and y are positively correlated – slower progression = slower relapse

Synthesis models: results

	ICER (for etanercept)	P(c/e)	EVPI
Linear pooling	£39,259	0.224	£141 mil
Weighted linear pooling	£37,749	0.297	£230 mil

- Short term effectiveness, utilities and costs associated with value
- The unknown parameters also associated with value (£24 mil in the un-weighted model, £42 mil in the weighted model)

Conclusions

- Parameterisation of structural uncertainty is important
- Elicitation is feasible
 - long and complex task
 - context specific
 - Correlation and conditioning difficult for experts
 - Specific parameters, complexity and cognitive burden.
- Appropriate synthesis?
 - Do experts provide independent pieces of information?
 - Are they heterogeneous?
 - Are weights appropriate?
- More structural uncertainty than we started with?