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Can we believe their beliefs?
Two tales of structured expert elicitation

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Two tales…

Photoacoustic imaging in breast cancer	**Negative-pressure wound therapy for pressure ulcers**
Context: new Dx imaging with *unknown* accuracy	Context: existing therapy with limited evidence base but *wide usage in practice*
Key parameters elicited: - relative performance Dx in detecting tumor characteristics - estimates of sensitivity and specificity of new Dx	Key parameters elicited: treatment and progression of severe pressure ulcers
Why: inform early stage cost-effectiveness model	Why: inform cost-effectiveness model an value of further research

Photo-Acoustic Mammography

- X-ray Mammogram
- Ultrasound
- MRI or PAM
- Biopsy
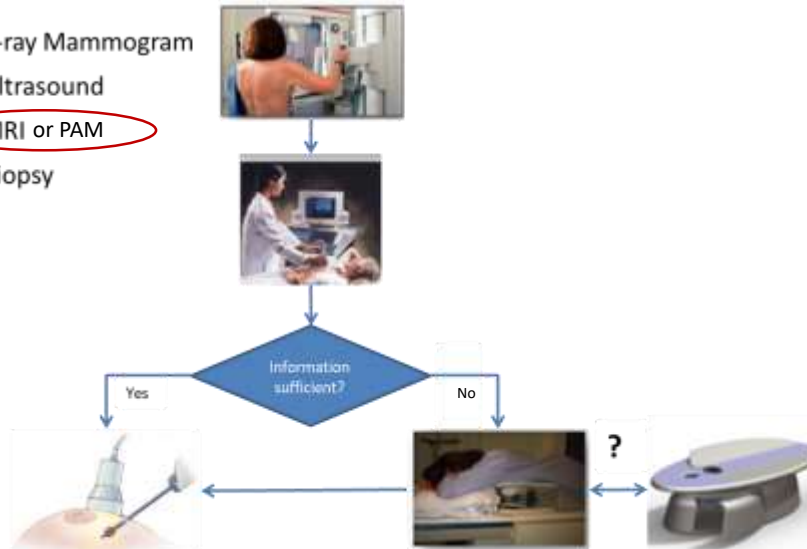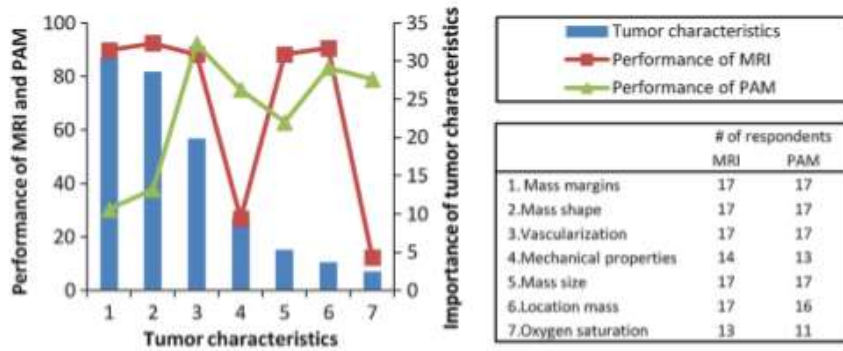

Rating relative performance of PAM versus MRI

Elicited:
1. relative importance seven tumor characteristics in the examination of images
   - using 0-100 point scale
2. how well MRI and PAM can visualize these characteristics by grading each characteristic with value 0 - 100
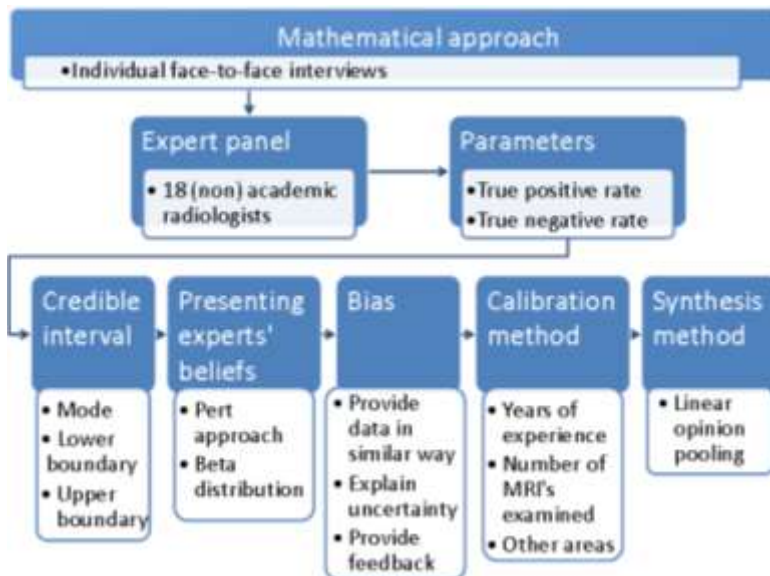   - 0 indicates low performance; 100 indicates high performance.

Expected performance of MRI and PAM was determined by calculating performance score weighted by the relative importance of each attribute, per individual

Tumor characteristics: mass margins; mass shape; mass size; vascularization; localization; oxygen saturation; and mechanical properties.

Elicitation Results

	# of respondents	
	MRI	PAM
1. Mass margins	17	17
2. Mass shape	17	17
3. Vascularization	17	17
4. Mechanical properties	14	13
5. Mass size	17	17
6. Location mass	17	16
7. Oxygen saturation	13	11

Elicitation Procedure for sensitivity and specificity

Table 3 Pooled MRI data

Test	Disease			
		Yes	**No**	**Total**
	Positive	263	94	357
	Negative	29	214	243
	Total	292	308	600

$$\text{sensitivity} = \frac{TPR}{TPR + FNR}$$

$$\text{specificity} = \frac{TNR}{FPR + TNR}$$

a Mode

b Lower and upper boundaries

c Probability distribution
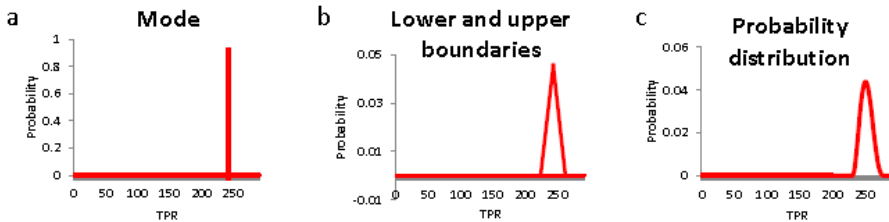
Eliciting the mode, than the upper and lower boundaries and by using the PERT approach a probability distribution was obtained.

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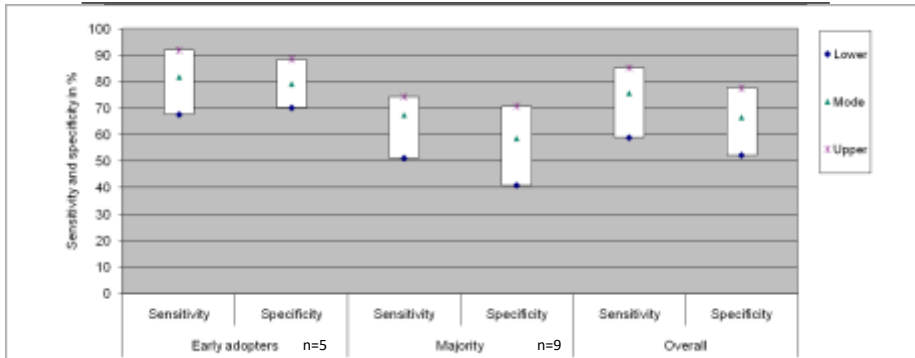Haakma, Steuten, Bojke and IJzerman. Submitted, 2012

Probability distribution of estimations of TPs
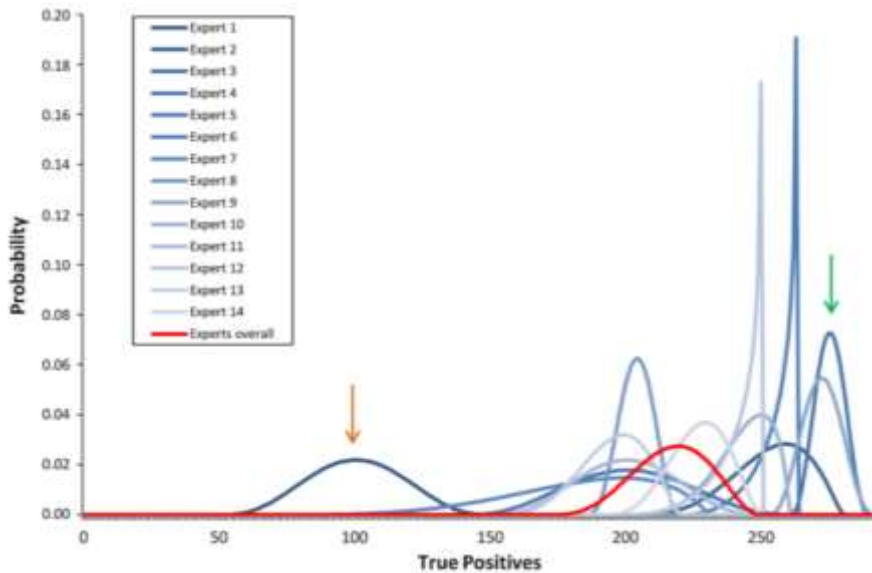
Haakma, Steuten, Bojke and IJzerman. Submitted, 2012

Results – Expert elicitation

	Early adopters			Majority			Overall		
	Lower	Upper	Mode	Lower	Upper	Mode	Lower	Upper	Mode
Sensitivity	67.7%	91.9%	**81.7%**	51.2%	74.3%	**67.4%**	58.9%	85.1%	**75.6%**
Specificity	70.2%	88.4%	**79.1%**	40.8%	70.7%	**58.5%**	52.2%	77.6%	**66.5%**

Haakma, Steuten, Bojke and IJzerman. Submitted, 2012

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Considerations

- Experts considered MRI (sens 90%; spec 70%) the better technology to visualize the most important tumor characteristics (mass margins and mass shape).
- Reflected in elicited TP and TN, with overall calculated sensitivity and specificity of PAM to be lower than MRI
  - Sens between 59% - 85%; mode 76%
  - Spec between 52% - 78%; mode 67%

- Radiologists perceived elicitation exercise as difficult
  - PAM is an early stage technology for which only small scale, experimental experience was available.

- Exercise provided important insights to the developers
  - Revision of the technology and reconsideration of its place in Dx pathway

## Negative-Pressure Wound Therapy for Pressure Ulcers

- NPWT is widely used treatment for severe pressure ulcers
  - little robust evidence that it is (cost-) effective
  - uncertainty around cost-effectiveness would potentially be misrepresented using published trial data only
  - broad range of comparators
  - general patterns of care unclear
  - yet, lots of local / practical experience with different therapies
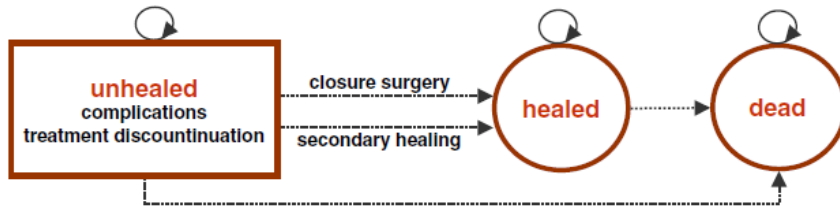
Objectives and design

Questions considered:

- Wat is the (cost-)effectiveness of NPWT given the range of alternative treatments?
- What further research (design), if any, is worthwhile?
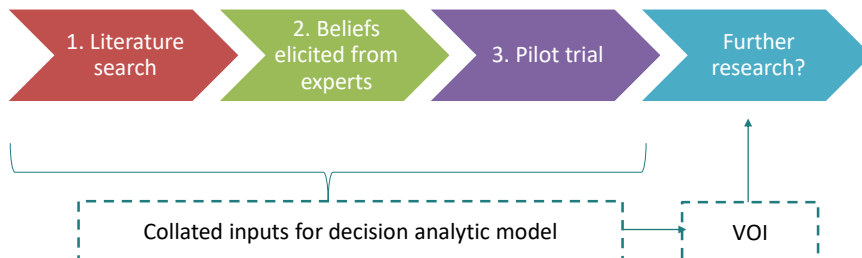
Decision Analytic Model

Elicitation of:

- all transitions and related events (except death)
  - including beliefs about the impact of the alternative treatments on the occurrence of events (relative effectiveness).
- uncertainty over the quantities of interest.
- no elicitation of resource use or cost parameters
  - to limit burden of exercise
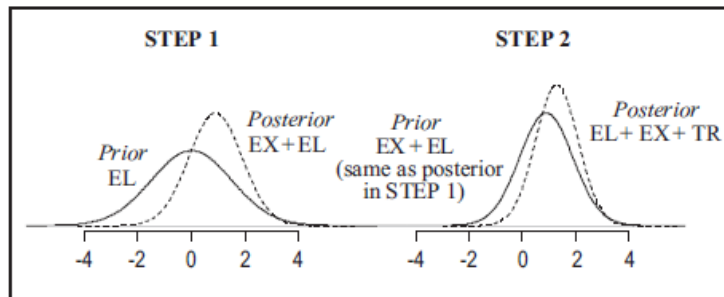
Elicitation procedure: histogram method

Think of UK patients with at least 1 debrided grade 3 or 4 pressure ulcer (>5 cm2 in area):
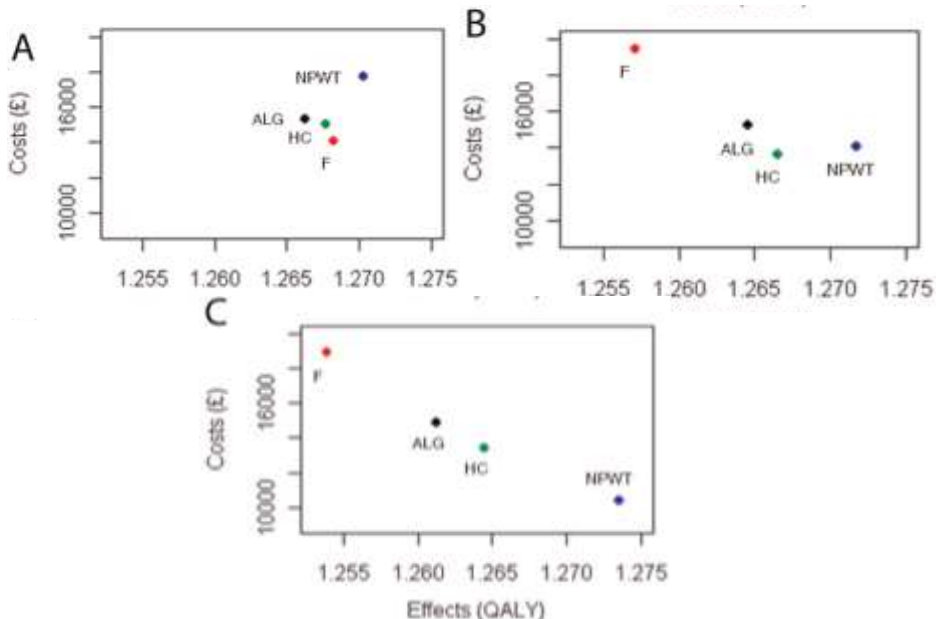
What proportion of patients do you think would have a grade 3 reference ulcer (rather than a grade 4 reference ulcer)?
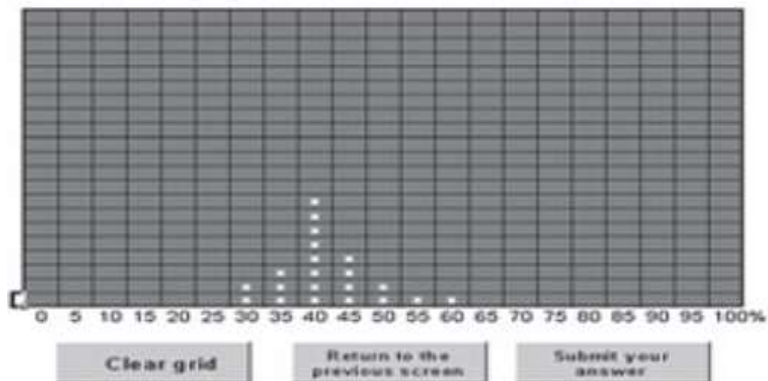
Collation of evidence using Bayesian updating:

Results on expected cost-effectiveness, per scenario

CE estimates and decision uncertainty (EX+EL+TR)

Treatment	Costs (£)	Effectiveness (QALY)	NHB (QALY)	Next Best ICER (£/QALY)	Probability of a Treatment Being Cost-Effective	
					£20,000	£30,000
NPWT	10,399	1.273	0.754	—	0.451	0.460
HC	13,461	1.264	0.591	Dominated	0.304	0.296
ALG	14,898	1.261	0.516	Dominated	0.230	0.231
F	18,969	1.254	0.305	Dominated	0.015	0.013

Note: NPWT = negative-pressure wound therapy; HC = spun hydrocolloid; ALG = alginate; F = foam; NHB = net health benefit; ICER = incremental cost-effectiveness ratio; QALY = quality-adjusted life year.

Optimal sample size and value of further research

Follow-up Time	NPWT v. Spun Hydrocolloid		NPWT v. Alginate		NPWT v. Spun Hydrocolloid v. Alginate	
	Maximum ENBS	Optimal Sample Size, N*	Maximum ENBS	Optimal Sample Size, N*	Maximum ENBS	Optimal Sample Size, N*
0.5 years	—	—	£12.3 million	272	£154,028	403
1 year	£14.0 million	476	£27.2 million	306	£34.7 million	497
2 years	£27.1 million	389	£35.2 million	234	£54.6 million	411

Considerations

- Elicited beliefs can be regarded as a key source of evidence
- Excluding relevant clinical experience would have misrepresented current knowledge about the effectiveness of alternative treatments for severe pressure ulcers.
- In this case study, elicited evidence was used alongside published evidence under the assumption that experts did not consider existing evidence when formulating their judgements.
  - Assumption may not be sustained in other cases, where aggregation of both sources could lead to an incorrect specification of uncertainty (double counting).

Discussion: pros and cons

- Elicitation of beliefs constitutes a reasonably low cost source of evidence;
  - Particularly important in early stage technology assessment when funding is limited, or when a technology is already adopted and there is little incentive to do further research.

- Elicitation is highly subjective and entirely dependent on the sample of experts chosen for the exercise.
  - Particular problematic when samples are skewed towards including mainly optimists or sceptics;
  - In early stage HTA 'realistic' beliefs may not yet exist due to no/limited experience with technology

Discussion: pros and cons

- Can provide preliminary estimates of the importance and extent of uncertainty for particular model parameters or assumptions
  - can help to inform go/no go decisions in early stage HTA and
  - guide decision on whether and what further evidence to acquire
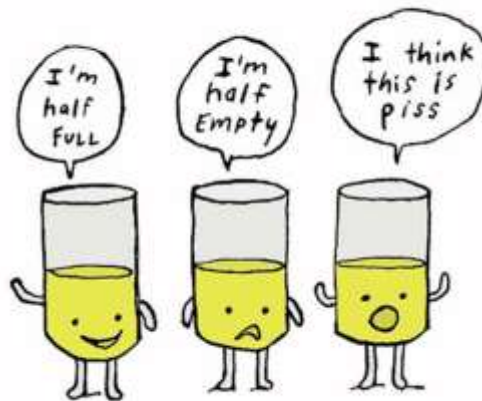
Thank you!

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