Health Technology Decision-Making in an Imperfect World: A Unifying Framework of Value of Information and Implementation Metrics Based on a Narrative Review

MSR169

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Background & Aim

- Value of information (VOI) analyses can support research prioritisation and design as they calculate the value of reducing uncertainty in decision-making
- Whilst population levels are commonly adjusted by implementation, individual VOI analysis implicitly assumes that future optimal interventions are fully implemented.
- This unrealistic assumption has driven the development of methods that consider the value of implementation alongside the value of information.
- **To review value of information and implementation concepts and develop a unifying taxonomy, aiming to improve the use of these methods going forward**

Proposed taxonomy

Definition	Previous Terminology	Previous Abbreviation	Proposed Terminology	Proposed Abbreviation
Assumes decision makers are fully rational in their implementation				
D-C	Expected Value of Perfect Information	EVPI	Expected Value of Perfect Information	EVPI
O-C	Expected Value of Sample Information	EVSI	Expected Value of Sample Information	EVSI
Assumes no further information is collected				
C-A	Expected Value of Perfect Implementation	EVPIM	Expected Value of Perfect Implementation	EVPIm
L-A	Expected Value of Specific Implementation Measure	EVSIM	Expected Value of Expanded Implementation	EVEIm
B-A	Realisable EVPI	-	Equal to 0	-
Information and levels of implementation both change				
D-A	Expected Value of Perfection	EVP	Expected Value of Perfect Information and Implementation	EVPIIm
N-A	Sensitivity analysis for realisable EVPI	-	Measures only improvement in implementation	-
M-A	Implementation Adjusted EVSI	IA-EVSI	Expected Value of Expanded Implementation (M=L, when the M is not impacted by the data)	EVEIm
	Research Expected Value of Specific Implementation Measure	$EVSIM^R$		
M_x-A	EVSI with imperfect implementation	-	Expected Value of Sample Expanded Implementation	EVSEIm
	Implementation-adjusted EVSI	$EVSI^{IM}$		
	Research EVSIM (Alternative Definition)	$EVSIM^R$		
(O-C)+(M-A)	Expected Value of Research	EVR = EVSI + EVSIM	Likely double-counting	-

Toy example: Reducing the risk of a critical event.

Two interventions reducing the risk of a critical event that has cost and quality of life implications, but the novel treatment comes with a risk of side effects, also with cost and quality of life implications. A decsion tree model evaluates its cost-effectiveness.

Methods

- Narrative review of value of implementation methods
- Clarification of use: value of research to reduce uncertainty vs value of research to improve implementation?
- Development of a unifying framework
- Illustration of implications in toy example

States of the world

Implementation	Information: Current	Information: Improved (Sample)	Information: Perfect
Current	A	K	B
Improved (Expanded)	L	M	N
Perfect	C	O	D

$$A = \sum_{d=1}^{D} \rho_d^C \mathrm{E}_{\boldsymbol{\theta}}[\mathrm{NB}_d(\boldsymbol{\theta})] \quad K = \mathrm{E}_X\left[\sum_{d=1}^{D} \rho_d^C \mathrm{E}_{\boldsymbol{\theta}|X}[\mathrm{NB}_d(\boldsymbol{\theta})]\right] \quad B = \mathrm{E}_{\boldsymbol{\theta}}\left[\sum_{d=1}^{D} \rho_d^C \mathrm{NB}_d(\boldsymbol{\theta})\right]$$

$$L = \sum_{d=1}^{D} \rho_d^E \mathrm{E}_{\boldsymbol{\theta}}[\mathrm{NB}_d(\boldsymbol{\theta})] \quad M = \mathrm{E}_X\left[\sum_{d=1}^{D} \rho_d^E \mathrm{E}_{\boldsymbol{\theta}|X}[\mathrm{NB}_d(\boldsymbol{\theta})]\right] \quad N = \mathrm{E}_{\boldsymbol{\theta}}\left[\sum_{d=1}^{D} \rho_d^E \mathrm{NB}_d(\boldsymbol{\theta})\right]$$

$$C = \max_d \mathrm{E}_{\boldsymbol{\theta}}[\mathrm{NB}_d(\boldsymbol{\theta})] \quad O = \mathrm{E}_X\left[\max_d \mathrm{E}_{\boldsymbol{\theta}|X}[\mathrm{NB}_d(\boldsymbol{\theta})]\right] \quad D = \mathrm{E}_{\boldsymbol{\theta}}\left[\max_d \mathrm{NB}_d(\boldsymbol{\theta})\right]$$

Toy example application

Metric	Additional information assumed to be:	Assumptions about implementation of novel treatment implicit to analysis or explicitly made: Without additional information	With additional information	Estimate ($)
EVPI	Perfect	equals probability cost-effective (implicit)	100% (implicit)	6,802
EVPIm	None	51.1% (explicit)	100% (explicit)	18,610
EVPIIm	Perfect	equals probability cost-effective for EVPI (implicit) and 51.1% for EVPIm (explicit)	100% (im- and explicit)	25,412
EVSI	Study QoL side effects, small N	equals probability cost-effective (implicit)	equals a posteriori probability cost-effective (implicit)	0
EVEIm		51.1% (explicit)	90% (explicit)	14,805
EVSI	Study probability side effects	equals probability cost-effective (implicit)	equals a posteriori probability cost-effective (implicit)	223
EVEIm		51.1% (explicit)	90% (explicit)	15,006

Conclusions

- We clarified the implications of adjusting VOI measures for implementation and **proposed a taxonomy** of value of implementation measures
- Importantly, some measures only consider improvement in implementation and NOT the effect of reducing uncertainty
- VOI implicitly assumes **«perfect» implementation**, but the interpretation of this is NOT that an intervention is implemented at 100%, but **in line with the probability of being cost-effective**
- If deviations of this are foreseen, this can be accounted for using the proposed measures, but **characterising the relationship between the strength of evidence and implementation** remains challenging

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ConVOI
Collaborative Network for Value of Information