

TDM	729.89	915.51	185.62	▲25.43%	FLR	660.27	745.28	85.01	▲12.88%
HUM	749.73	924.29	174.56	▲23.28%	UVD	155.59	181.57	25.98	▲16.70%
DMW	833.72	1004.01	170.29	▲20.43%	QUV	440.55	540.21	99.66	▲22.62%
YZJ	903.49	1127.46	223.97	▲24.79%	HZT	285.51	344.98	59.47	▲20.83%
GLY	982.07	1219.39	237.32	▲24.17%	PCW	811.44	1029.66	218.22	▲26.89%
VDA	113.74	143.41	29.67	▲26.09%	AIK	361.77	451.39	89.62	▲24.77%
UVV	468.08	535.41	67.33	▲14.38%	ZJJ	858.36	994.57	136.21	▲15.87%
HJS	545.49	659.05	113.56	▲20.82%	RHJ	894.79	1046.68	151.89	▲16.97%
EBC	566.96	664.69	97.73	▲17.24%	VQV	425.08	509.95	84.87	▲19.97%

PPJ	912.63	1038.36	125.73	▲13.78%	ZGK	391.59	491.48	99.89	▲25.50%
UAQ	1309.55	1655.62	346.07	▲26.43%	BNY	969.21	1130.65	161.44	▲16.57%
DAQ	1295.17	1641.66	346.49	▲26.75%	SOM	735.44	913.39	177.95	▲24.20%
PNR	654.33	775.84	121.51	▲18.57%	TQQ	1323.91	1646.42	322.51	▲24.36%
ZTM	81.59	100.52	18.93	▲23.33%	OIS	543.42	667.21	123.79	▲22.78%

AI for Health Economic Evaluation

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Centre for the Business and Economics of Health,
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Key take home

- Purpose of economic evaluation is to support transparent, structured decision making that brings all parties to understand the benefits, costs and uncertainty
- AI can be a bigger fancier black box – opposite of good practice; BUT can reduce the cost of prediction:
 - Evidence synthesis and automation
 - Automate reviews and data extraction and synthesis
 - Economic modeling
 - Support modeling
 - Real-World Evidence
 - Enables greater utilization of data to inform models and predict parameters of interest
- Challenges
 - Accuracy, Reliability, Transparency, Validity, Risk of bias

<https://doi.org/10.1186/s13561-025-00645-4>

<https://doi.org/10.1016/j.jval.2024.10.3846>

Background

“Economics is the science of choice”
(Robbins, 1932)

“Individuals make pretty bad decisions — decisions they would not have made if they had paid full attention and possessed complete self-control”
(Thaler, 2008)

Economic evaluation is to provide a structured approach, evidence-based framework for optimizing the allocation of scarce health resources to maximise health outcomes

“Prediction is at the heart of making decisions under uncertainty” (Goldfarb, Agrawal, Gans, 2018)

Artificial Intelligence

- AI (predictive and generative) is all about connecting inputs with outputs
 - Identifies complex patterns in data to form rules and make predictions
 - Uses these those learned patterns to create new content incl. text
 - Instead of millions of rigid rules, AI is taught by millions of examples
 - Reinforcement learning : Pavlov's dog
- Open source / generic AI more likely to be optimized for likes rather than accuracy

$$Y = \hat{Y} = b_1x_1 + b_2x_2 + b_3x_3, e$$

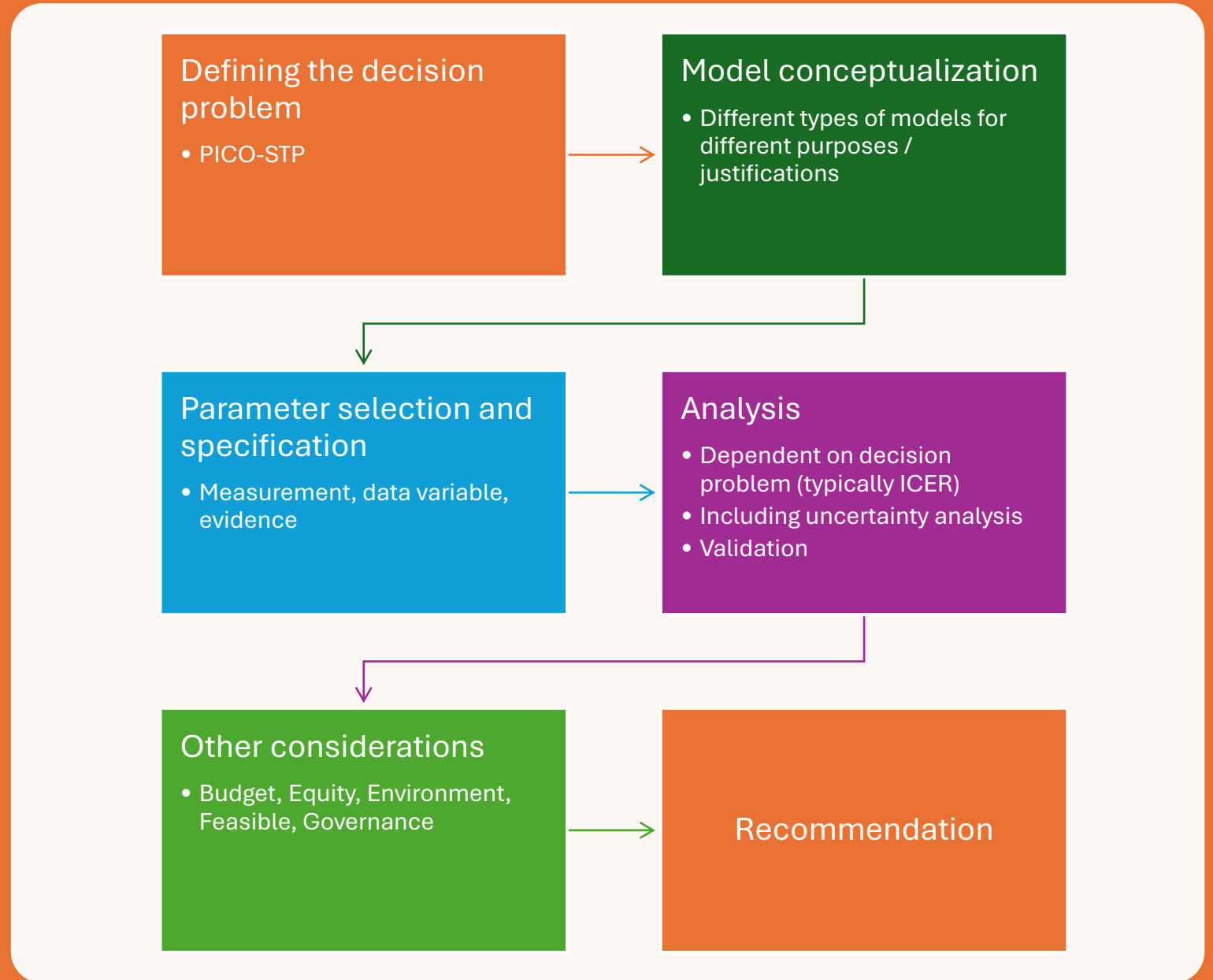
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Overview

- Provide worked examples of AI in each step of economic evaluation
 - ChatGPT: free, online, utilises math packages

Steps in an economic evaluation of technology in health



Defining the decision problem

- **PICO – STP**
 - **P:** Population (and setting);
 - **I:** Intervention (what by who, when, how many times, for how long);
 - **C:** Comparator (the alternative);
 - **OF:** Outcome Framework (cost +/- intermediate vs. final outcome; natural units vs utility vs monetary value - > cost-min. cost effectiveness cost-utility cost-benefit)
 - **S:** Study design (within-trial vs. model-based analysis)
 - **T:** Timeframe (horizon over which costs and outcomes considered)
 - **P:** Perspective (societal, system, organization/budget)

AI ?

“can you provide a population, intervention, comparator, outcome, study design, timeframe and perspective for an economic evaluation of an allied health led hospital in the home program ”

A trial-based cost–utility analysis will be conducted alongside a pragmatic controlled study comparing an allied health–led Hospital in the Home program with standard inpatient care. The analysis will adopt a health system perspective over a 90-day time horizon. Health outcomes will be measured in quality-adjusted life years derived from EQ-5D. Resource use will be collected prospectively and valued using hospital cost data. Incremental cost-effectiveness ratios will be calculated, with uncertainty explored using bootstrapping and probabilistic sensitivity analysis in accordance with CHEERS 2022 reporting standards.

“same for a new clinic to improve management of diabetes and kidney disease”

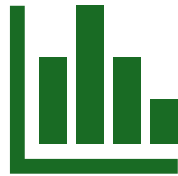
A model-based cost–utility analysis will evaluate a multidisciplinary diabetes–kidney disease clinic compared with usual care from a health system perspective over a lifetime horizon. Health outcomes will be expressed as quality-adjusted life years. A Markov model will simulate CKD progression, dialysis initiation, cardiovascular events, and mortality. Costs will include clinic delivery, hospitalisations, dialysis, and medication use. Both costs and outcomes will be discounted at 5% annually. Incremental cost-effectiveness ratios and probabilistic sensitivity analyses will be reported in accordance with CHEERS 2022 reporting standards.

Model conceptualization



Articulate the natural process of care and/or the progression of disease, linking intermediate to final outcomes

c.f. cost-consequence (cost per many outcomes, often not linked or scaled)



Blueprint for mathematical model to estimate final outcomes (e.g. costs and QALY) and estimate result from economic evaluation (e.g. incremental cost per QALY)

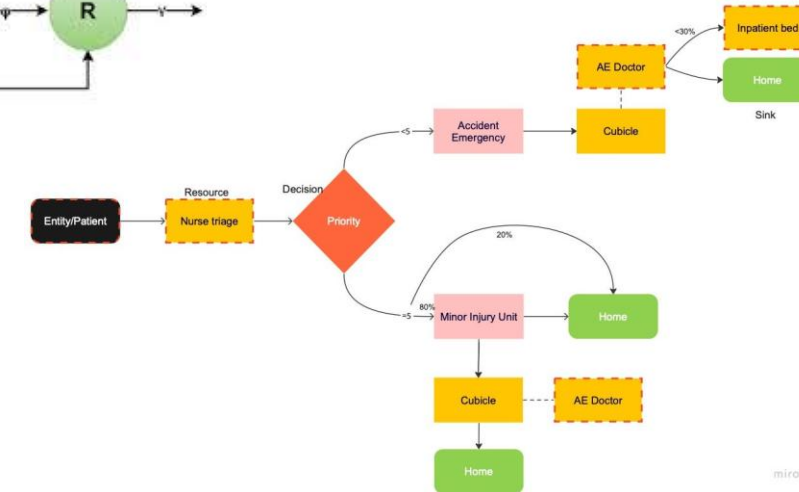
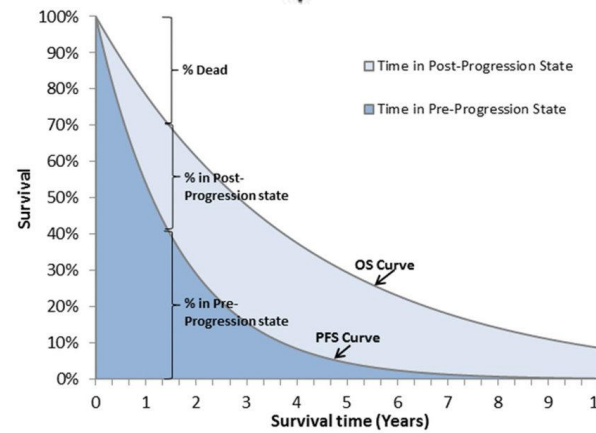
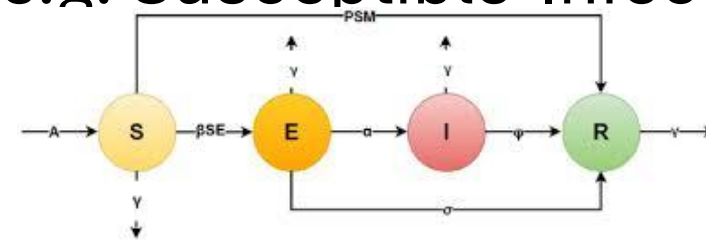
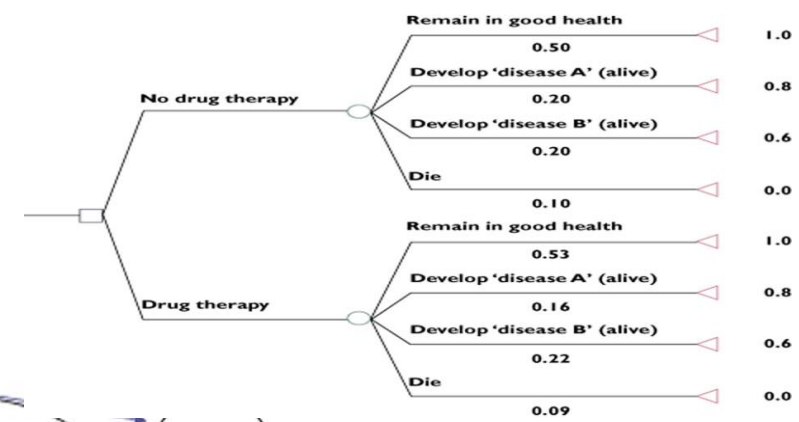
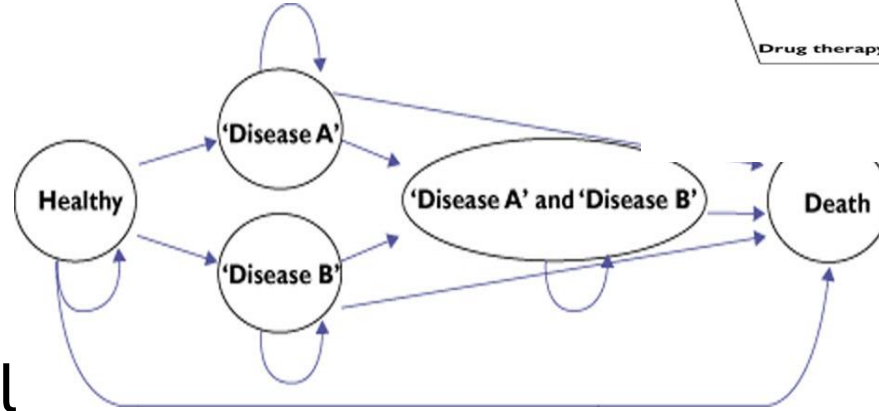


Literature is somewhat scant... but typically includes review of previous models in literature (same and related disease or intervention/comparator); clinician input, consumer input, process to establish face validity

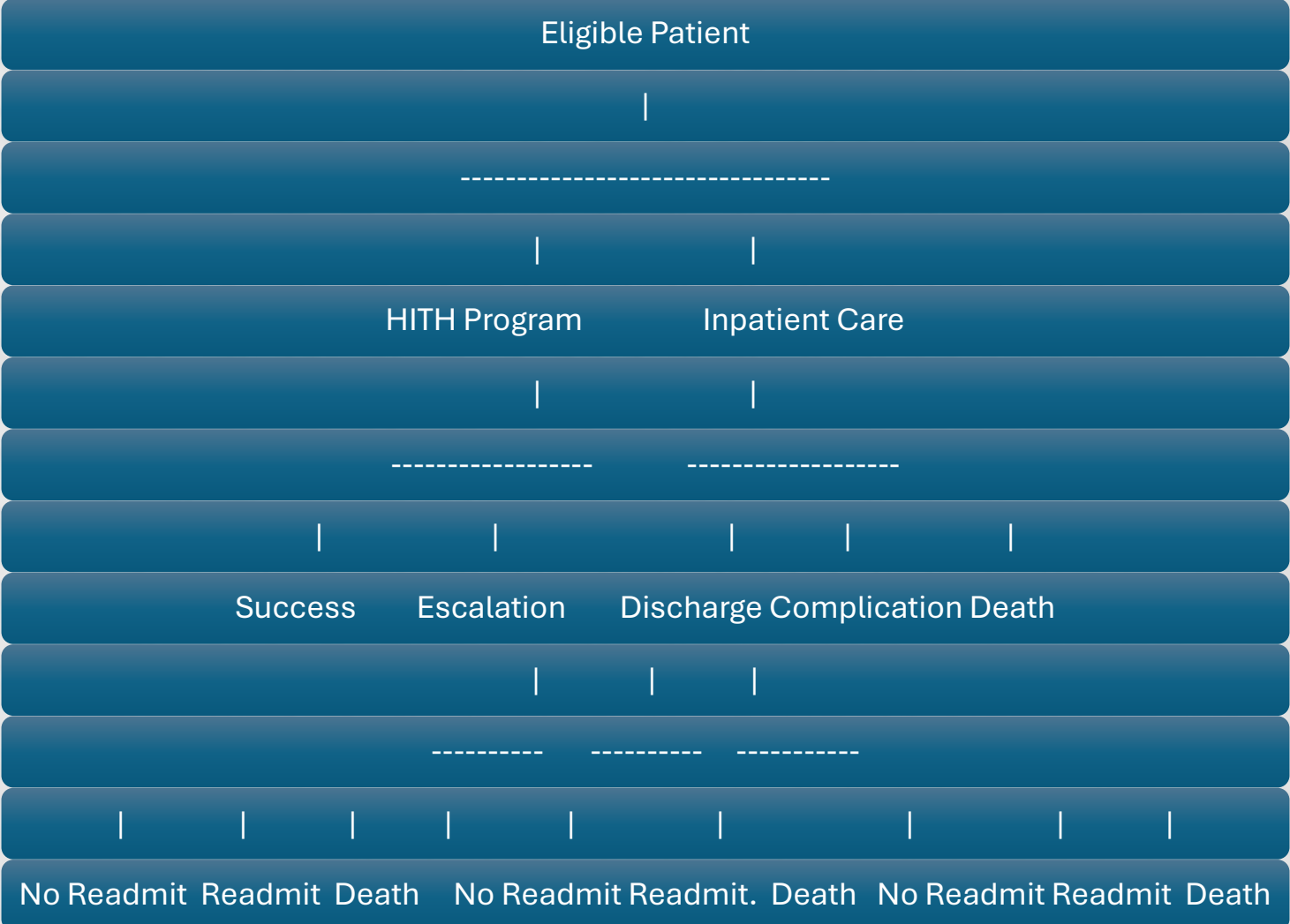
<https://doi.org/10.1017/S0266462324000539>

'Typical' model structures

- Decision tree
- Markov model
- Individual simulation model
- Dynamic transmission model (e.g. Susceptible-Infectious-Recovered)
- Partitioned survival analysis
- Discrete event simulation
- Agent based model

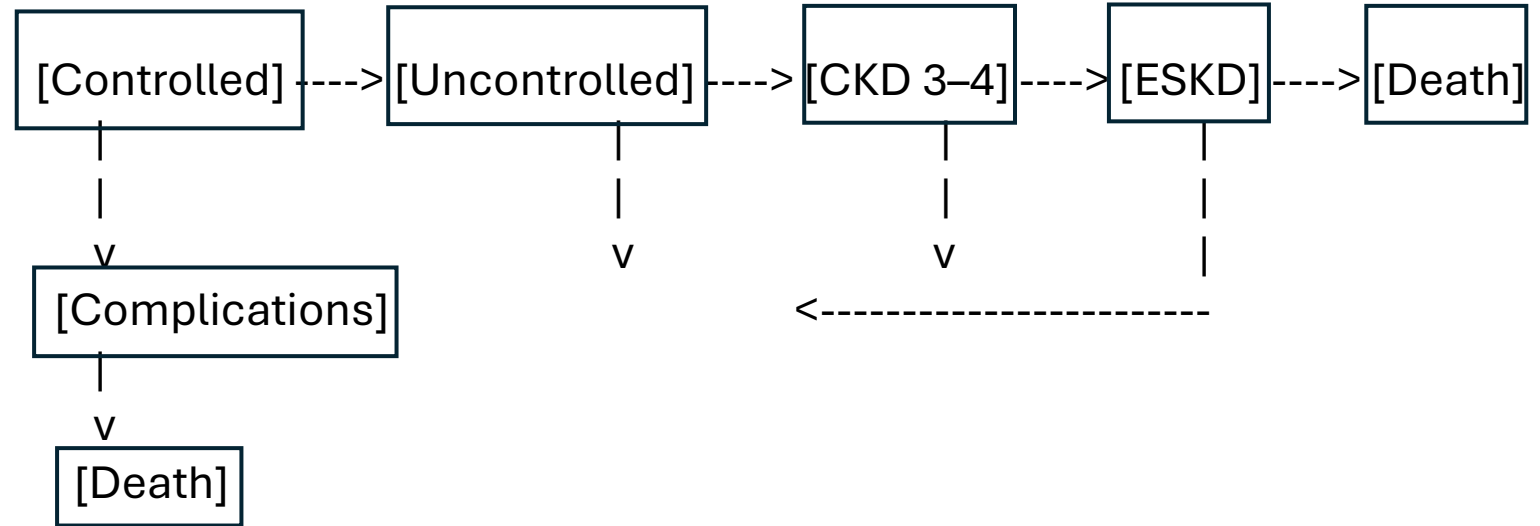


AI - Decision tree HITH

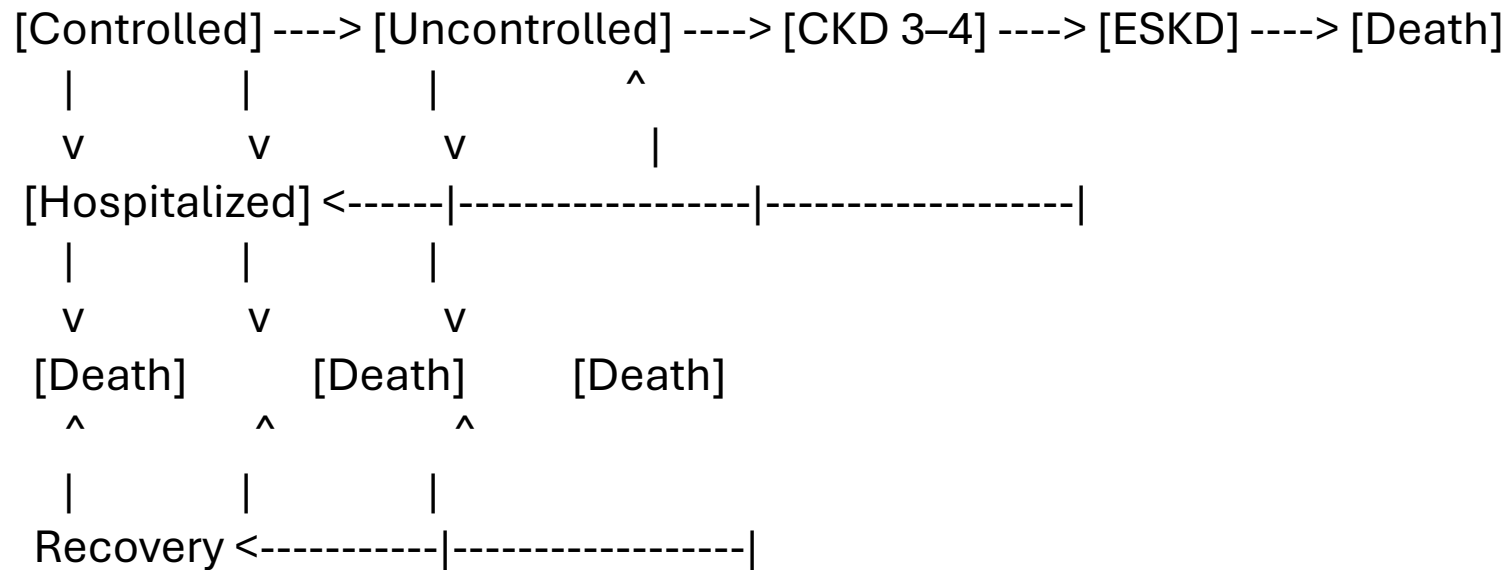


AI

- Markov model



- “include hospitalization transition events”



Parameter selection and specification

Data and evidence dependent

- What you may want – you may not have or be able to collect
- Differing levels of evidence necessary dependent on the importance in the model (a priori can be difficult)
- Importance of literature reviews + critical appraisal

Parameter choice

- Measurement e.g. FEV1 vs. PEF (not interchangeable / poor agreement)
- Continuous vs. categorical
- Rates vs. probabilities;

Causal link

- Vaping as a gateway drug; moderate drinking is healthy; prostate screening + early intervention; in-hospital early mobilisation

AI parameters - HITH

- “parameter values with plausible ranges”
- “provide sources for each parameter”
- “full sources table”
- “can you amend the table to be each parameter in the model with base case estimate, distribution type and parameters and source for value as the columns”
- “excel redy format”

Parameter Name	Description	Base Case	Distribution	Param1	Param2	Units	Source
p_HITH_escalation	Escalation from HITH to inpatient admission	0.15	Beta	30	170	Probability	Leong et al. 2021 BMJ Open
p_HITH_readmission_90d	90-day readmission after HITH	0.18	Beta	36	164	Probability	Leong et al. 2021 BMJ Open
p_HITH_mortality_90d	90-day mortality after HITH	0.02	Beta	10	490	Probability	Caplan et al. 2012 MJA
p_IP_complication	Inpatient complication rate	0.12	Beta	24	176	Probability	Leong et al. 2021 BMJ Open
p_IP_readmission_90d	90-day readmission after inpatient care	0.22	Beta	44	156	Probability	Leong et al. 2021 BMJ Open
p_IP_mortality_90d	90-day mortality after inpatient care	0.03	Beta	15	485	Probability	Caplan et al. 2012 MJA
cost_HITH_episode	HITH episode cost	3500	Gamma	16	219	AUD	Caplan et al. 2002 MJA
cost_escalation_admission	Escalation hospital admission cost	6500	Gamma	16	406	AUD	Leong et al. 2021 BMJ Open
cost_readmission	Hospital readmission cost	6500	Gamma	16	406	AUD	Leong et al. 2021 BMJ Open
cost_inpatient_index	Initial inpatient admission cost	8000	Gamma	16	500	AUD	Caplan et al. 2002 MJA
cost_complication_increment	Incremental cost of inpatient complication	3000	Gamma	16	188	AUD	Leong et al. 2021 BMJ Open
u_HITH_home	Utility during HITH episode	0.75	Beta	150	50	Utility	Leong et al. 2021 BMJ Open
u_inpatient	Utility during inpatient stay	0.65	Beta	130	70	Utility	Caplan et al. 2012 MJA
u_post_discharge	Utility post discharge recovery	0.8	Beta	160	40	Utility	Leong et al. 2021 BMJ Open
u_complication	Utility during complication state	0.55	Beta	110	90	Utility	Leong et al. 2021 BMJ Open

AI parameters – diabetes/CKD clinic

- “produce table of parameters for using this Markov model to do economic evaluation”
- “include source for each parameter along with distribution type and parameters”
- “Australian setting”
- “Excel ready table”

Parameter	Base Case	Range / 95% CI	Distribution	Unit	Source / Notes
Prob(Control, Üí Uncontrolled)		0.10.05,Äi0.20	Beta	Probability	Assumed (clinic audit/local cohort)
Prob(Uncontrolled, Üí Control)		0.150.10,Äi0.25	Beta	Probability	Intervention effect; multidisciplinary clinic literature
Prob(Uncontrolled, Üí CKD 3,Äi4)		0.080.05,Äi0.12	Beta	Probability	International CKD progression rates
Prob(CKD 3,Äi4, Üí ESKD)		0.050.03,Äi0.10	Beta	Probability	International CKD literature
Prob(Control, Üí Hospitalized)		0.020.01,Äi0.05	Beta	Probability	Low complication rate
Prob(Uncontrolled, Üí Hospitalized)		0.10.05,Äi0.20	Beta	Probability	Higher complication rate
Prob(CKD 3,Äi4, Üí Hospitalized)		0.150.10,Äi0.25	Beta	Probability	CKD complications (Australian registry)
Prob(ESKD, Üí Hospitalized)		0.20.15,Äi0.30	Beta	Probability	Dialysis-related hospitalizations (AIHW)
Prob(Hospitalized, Üí Death)		0.050.02,Äi0.10	Beta	Probability	Observed in-hospital mortality
Prob(Hospitalized, Üí Previous State)		0.950.90,Äi0.98	Beta	Probability	Recovery after hospitalization
Background mortality (age-specific)	Life table	-	Life table	Probability	Australian life tables (AIHW)
Cost: Non-dialysis hospital admission		84006000,Äi12000	Gamma	AUD/person-yr	Stage 4 CKD hospital costs (BMCHSR 2024)
Cost: Emergency & non-admitted services		1028700,Äi1500	Gamma	AUD/person-yr	Stage 4 CKD emergency visits
Cost: Dialysis (ESKD)		3698230000,Äi500000	Gamma	AUD/person-yr	Stage 5 dialysis costs
Cost: Medications (diabetes + CKD)		25001500,Äi3500	Gamma	AUD/person-yr	PBS / Australian dispensing data
Cost: Primary care & allied health		500300,Äi800	Gamma	AUD/person-yr	GP & allied health visits
Cost: New clinic (multidisciplinary)		800600,Äi1200	Gamma	AUD/person-yr	Specialist + allied time
Utility: Controlled diabetes & CKD		0.850.80,Äi0.90	Beta	QALY weight	EQ-5D; diabetes QoL literature
Utility: Uncontrolled		0.750.70,Äi0.80	Beta	QALY weight	Lower QoL with poor control
Utility: CKD 3,Äi4		0.650.60,Äi0.70	Beta	QALY weight	Moderate CKD utility
Utility: ESKD / Dialysis		0.50.40,Äi0.60	Beta	QALY weight	Dialysis QoL literature
Utility: Hospitalized (temporary)		0.40.30,Äi0.50	Beta	QALY weight	Temporary disutility during admission
Utility: Dead		0	0Fixed	QALY weight	Absorbing state
Discount rate: costs		0.050,Äi0.05	Fixed	%	PBAC guideline
Discount rate: QALYs		0.050,Äi0.05	Fixed	%	PBAC guideline

Analysis



After populating the model with parameter we use the model for estimating our results (ICER / CBR, uncertainty analysis) using associated formula / simulation



Can be done using different software

Excel; TreeAge; R/STATA



Iterative process to 'debug' along the way



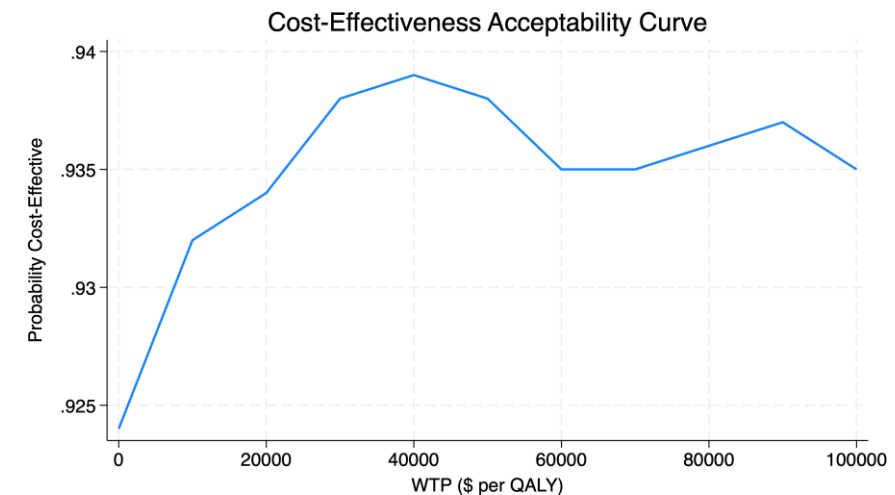
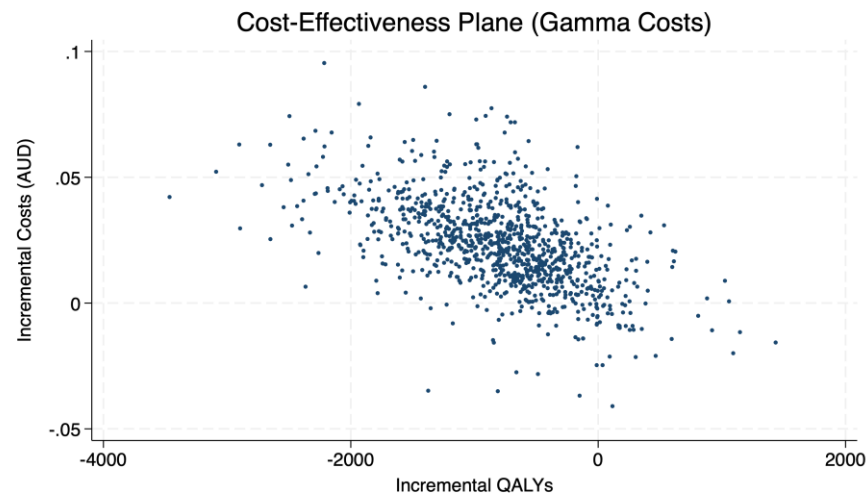
Validity testing

Computational, internal and external (if possible)

AI - analysis

- HITH decision tree
(46 attempts)
- Required 'forcing'
- STATA - not natural

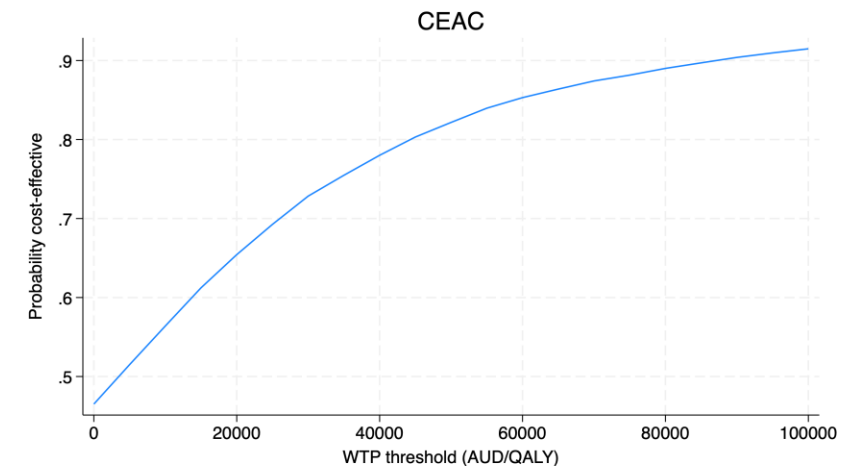
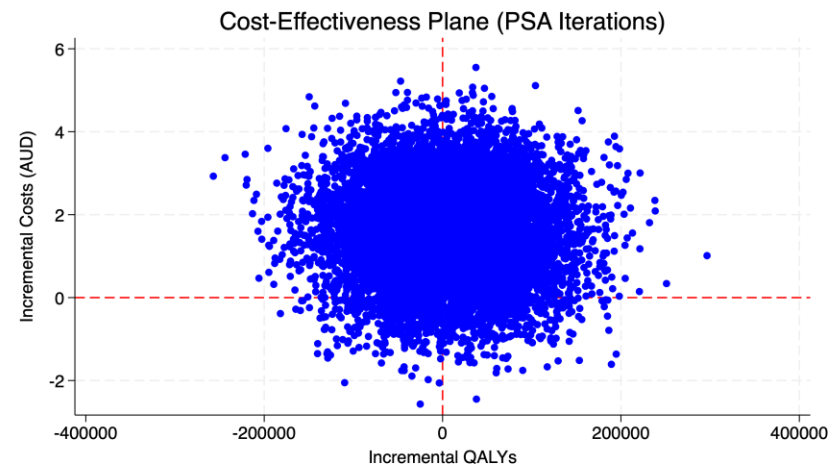
measure	mean	lower	upper
Incremental Cost	-\$797.12	-\$2,224.63	\$303.02
Incremental QALY	0.0232	-0.011	0.062
ICER	-\$37,366.80	-\$184,423.70	\$102,242.34



AI - analysis

- Diabetes and Kidney clinic – Markov model
- 20 attempts
- STATA - not natural

Metric	Mean	P2_5	P97_5
Incremental Cost	\$ (126,582.38)	\$ (126,582.38)	\$ 134,247.48
Incremental QALY	(33,651.60)	(0.66)	3.72
ICER	\$ (33,651.60)	\$ (285,581.81)	\$ 323,926.88



Other consideration

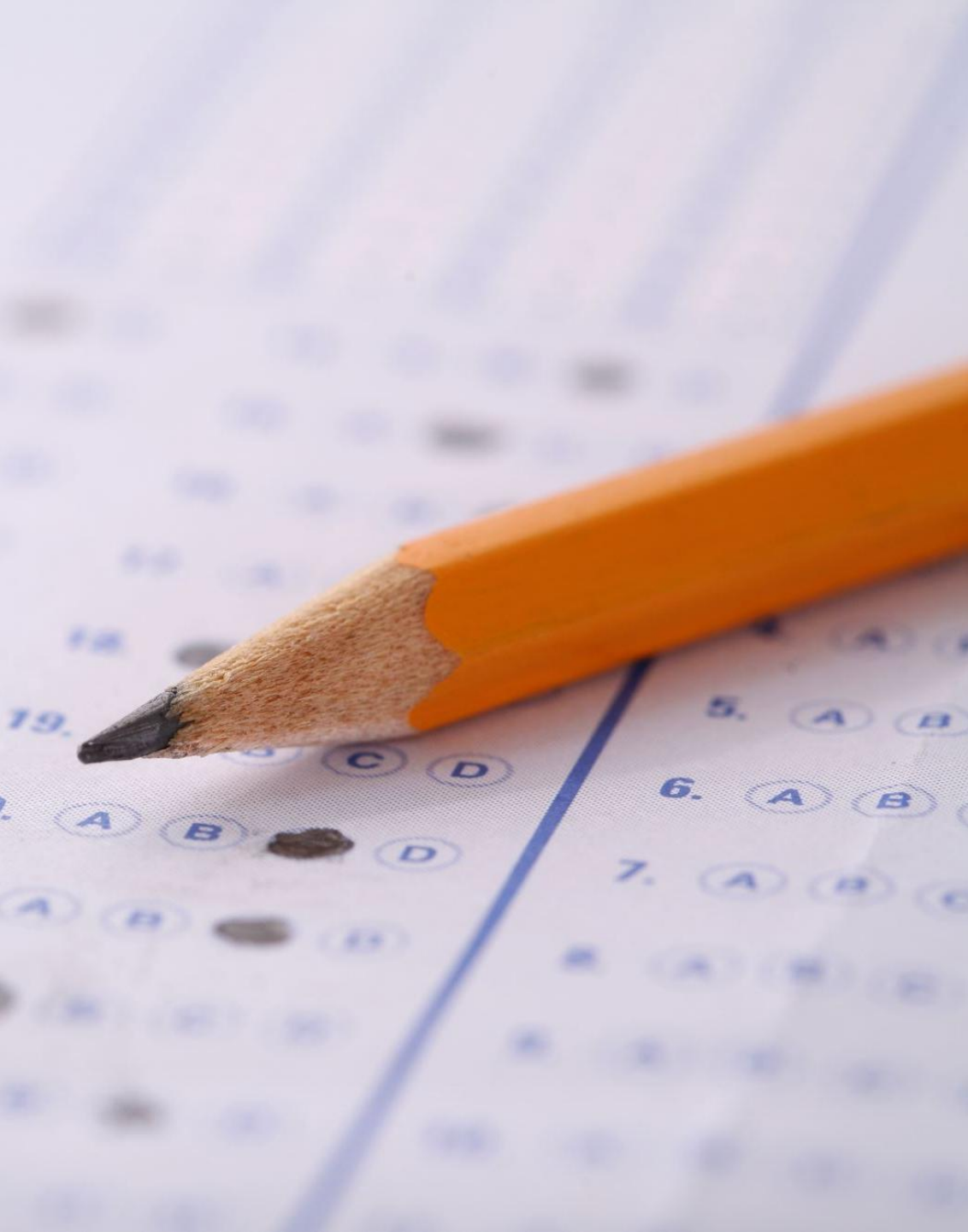
- Economic evaluation is only one criteria by which a decision maker may address a problem / solution
- Increasing formal consideration of other factors within economic evaluation and modelling but remains dependent on decision making processes writ large e.g. deliberative discussion

AI – other considerations

- Budget impact analysis
 - Capacity and hospital flow effects
 - Equity and access considerations
 - Workforce implications
 - Implementation and transition costs
 - Patient and carer costs
 - Safety and clinical governance
 - Alignment with national policy priorities
 - Scalability and generalisability
- “can you provide of additional considerations to include alongside this Econ eval that may be of interest to Australian decision makers”

Greater application and future

- Above examples based on open free AI platform
 - Quick, free, 'dirty'
 - Surprisingly provides relatively good insights along the way – not just an answer but consideration of assumptions, additional and alternative approaches, summary of methods and justification text
 - 'trained' externally and sourcing info 'cheaply'
- Areas of current application not included here
 - Systematic literature review, data extraction, storage and meta-analysis
 - Data analysis, extrapolation and generalizability
 - integration into organization data
- Future (Econ Eval)
 - More complex system and agent based models
 - Bespoke AI packages that are 'trained' for econ evaluation
 - Integrated with organization and system data to generate model structures and data inputs
 - Continued upskilling in use of AI and interrogation of AI generated outputs – which may be AI



Summary

- Yes, but...
 - Don't rely on it blindly
 - Pull out in a way that enables scrutiny
 - Validation, validation, validation
 - Every decision has two components: prediction and judgment
 - Judgement requires humans !
- (Agrawal, Gans and Goldfarb, 2018)