

Introduction to Decision Analysis

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Outline

1. Introductions
2. Motivation
3. Examples of Decision Analysis
4. Workshop objectives

Course Website

<https://graveja0.github.io/vital-istanbul-2024/>

- All course materials (slides, case studies) are posted here.
- Our (likely evolving) schedule will also be posted here, and updated regularly.

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Introductions

- Please introduce yourself!

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Motivation

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The Past Two Decades ...

- Cured Hepatitis C
- Significantly reduced incidence of HIV
- Potential cure for relapsed/refractory leukemia & lymphoma
- Perfected vaccines (e.g. HPV vaccine) to prevent diseases such as cervical & other cancers
- Strides in preventing cardiovascular disease

Despite these advances ...

- Burden of non-communicable diseases (NCDs) like cancer, cardiovascular disease, and diabetes is growing.
- NCDs are the cause of 74 percent of deaths globally, with most (86%) of those deaths in low- and middle-income countries (LMICs)
 - Source: [WHO](#)
- Rates also remain high in many parts of the world for malnutrition, unmet need for sexual and reproductive health services, and maternal mortality.

Despite these advances ...

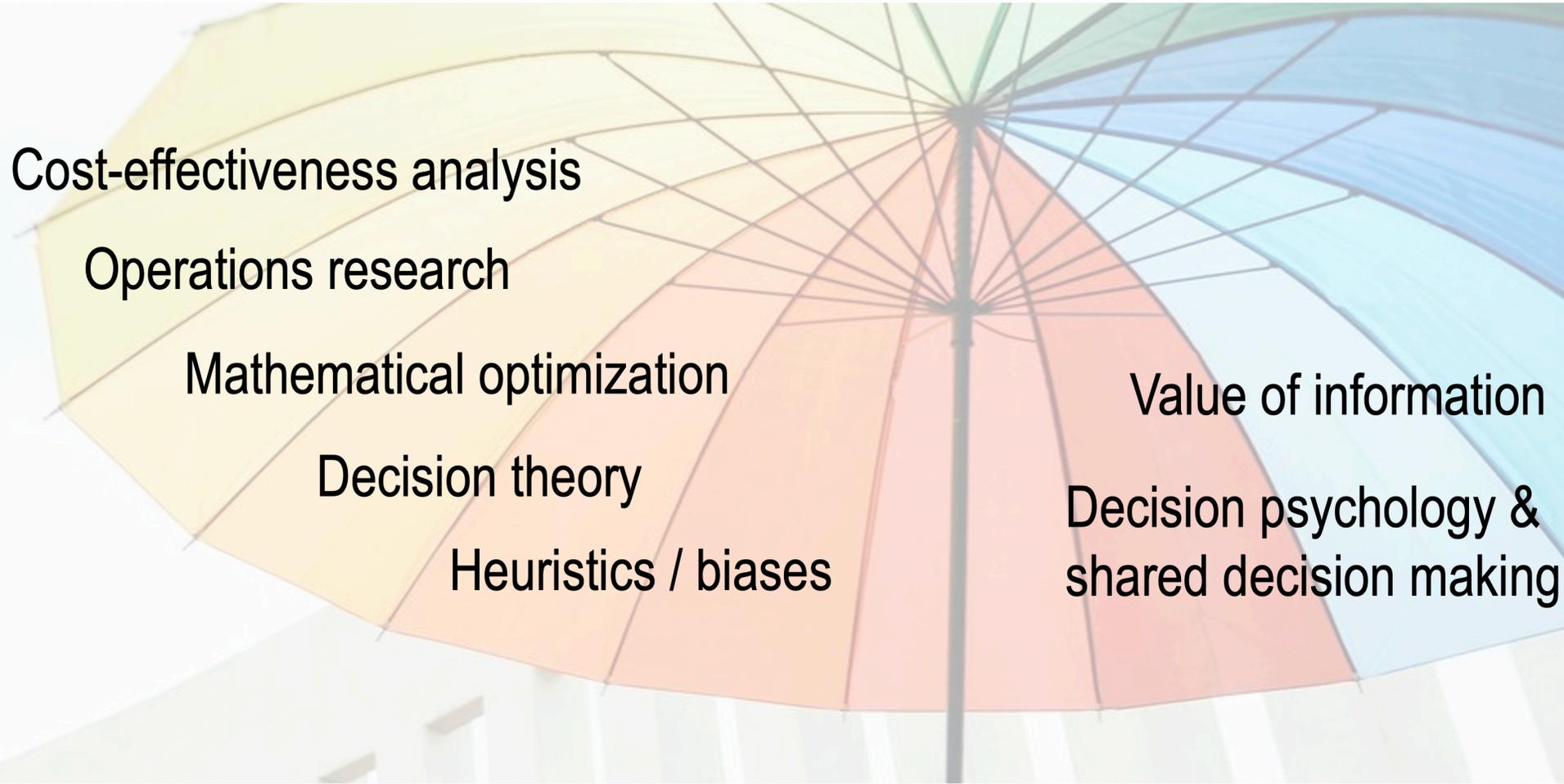
Governments cannot afford all the healthcare from which people could possibly benefit

- Either implicitly or explicitly, we make choices about which programs to fund, which populations to screen, and which expensive new drugs to provide to which patients
- **Decision Analysis can help us ensure that we prioritize the highest value care possible at an efficient price point**

Decision Analysis

Decision analysis is a methodology that is uniquely beneficial when there are meaningful tradeoffs between healthcare interventions, but the best strategies for obtaining optimal outcomes are uncertain.

DECISION ANALYSIS



Cost-effectiveness analysis

Operations research

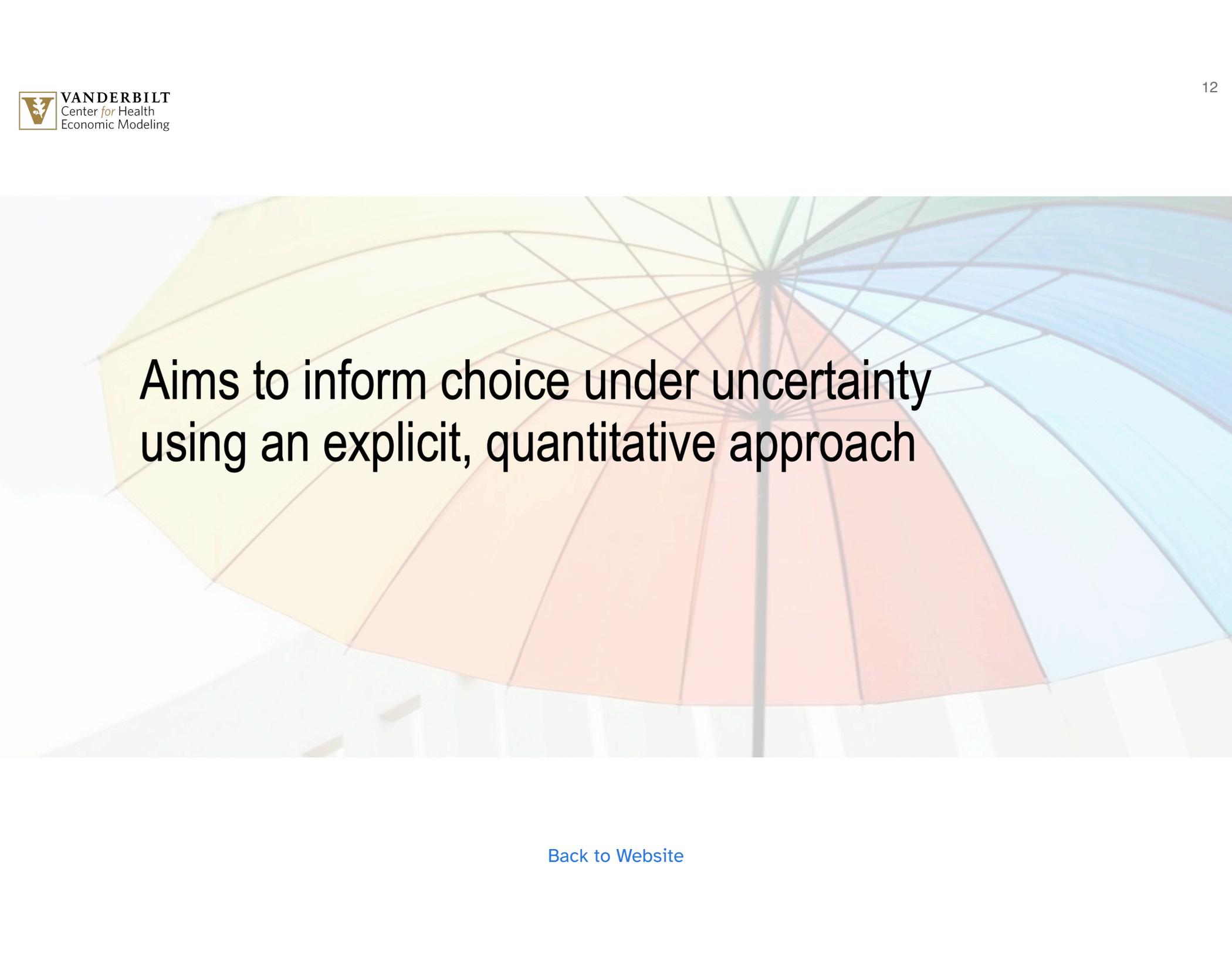
Mathematical optimization

Decision theory

Heuristics / biases

Value of information

Decision psychology &
shared decision making



**Aims to inform choice under uncertainty
using an explicit, quantitative approach**

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Economists have long defined value as “outcomes relative to costs”

> If we only consider benefits when we define value, it's no different than efficacy or effectiveness research. And we obviously don't want to just consider costs without benefits!

Examples of Decision Analyses

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EX 1. HIV

You have been appointed as Director of a funding allocation committee responsible for prevention & treatment initiatives for HIV.

1. How will the committee decide on the proportion of funds for prevention efforts versus treatment?
2. Should any of the funds be used for research?
3. How do you respond to a member who argues that the funds are better spent on childhood vaccinations?

EX 2. Birth Defects

- A hypothetical birth defect is present in every 1 in 1,000 children born
- Unless treated, this condition has a 50% fatality rate

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Should we test for this hypothetical birth defect?

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EX 2. Birth Defects

Should we test for this hypothetical birth defect?

- Diagnostic test: Perfectly accurate
- All newborns in whom the defect is identified can be successfully cured
- BUT the test itself can be lethal:
 - **4 in every 10,000** infants tested will die as a direct and observable result of the testing procedure

EX 2. Birth Defects

Objective: Minimize total expected deaths

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EX 2. Birth Defects

Objective: Minimize total expected deaths

- Consider a population of **100,000** newborns
- **Testing** produces: $(0.0004 \times 100,000) = 40$ expected deaths
- **No testing** produces: $(0.001 \times 0.5 \times 100,000) = 50$ expected deaths
- **Looks like TESTING WINS!**
- **Anyone got a problem with this??**

Different lives are lost

- With **testing**, virtually all 40 deaths occur in infants born without the fatal condition.
- With **no testing**, all 50 expected deaths occur from “natural causes” (i.e. unpreventable birth defect)

Different lives are lost

- “Innocent deaths” inflicted on children who had **“nothing to gain”** from testing program
- We may treat one child’s death as more tolerable than some other’s – even when we have no way, before the fact, of distinguishing one infant from the other.

EX 3. Substance use treatment in pregnancy

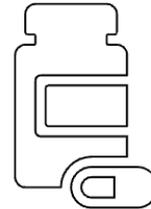
Another example of “Competing interests”

[Leech AA, 2024]

EX 3. Opioid/substance use in pregnancy

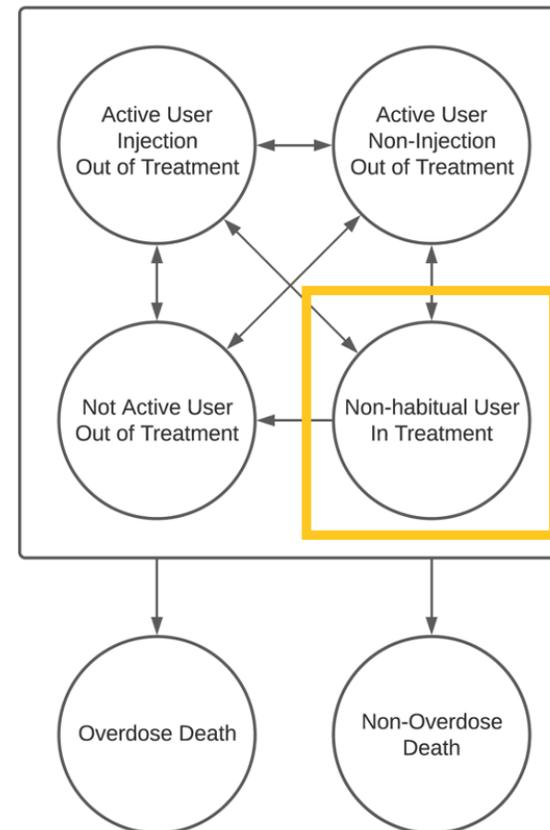
[Leech AA, 2024]

METHODS



Discrete event simulation model
 (stochastic time-to-event model)
 comparing opioid use disorder
 treatment strategies

Opioid Use States



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EX 3. Opioid/substance use in pregnancy

[Leech AA, 2024]

METHODS

Outcomes



Prenatal



Postpartum

Return to illicit use,
overdose, costs, QALYs,
net health benefit



Infant, YR 1



Infant, lifetime

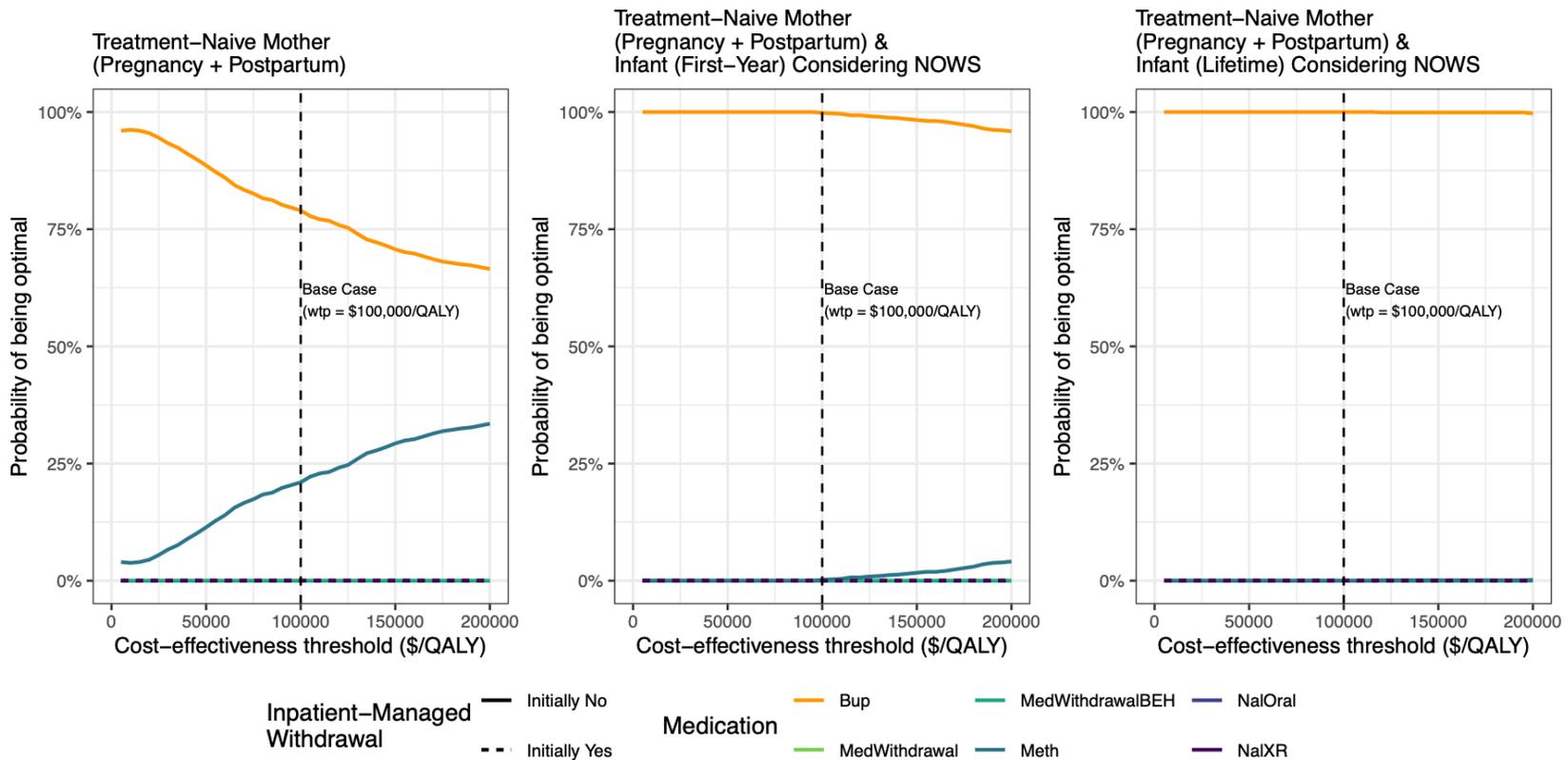
Pre-term birth, low-birth
weight, neonatal opioid
withdrawal syndrome, Infant
death, discounted costs,
discounted QALYs, net health
benefit

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EX 3. Opioid/substance use in pregnancy

[Leech AA, 2024]

Figure 2a. Main analysis Cost-Effectiveness Acceptability Curves



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EX 3. Opioid/substance use in pregnancy

- The clear winner is buprenorphine!!
- Yes, BUT...
- We know that clinically, patient choice is really important for retention outcomes
- We can also see that our final conclusions are driven by the infant outcomes (methadone actually has better retention outcomes)
- We did not simulate the birthing parent over their lifetime

EX 3. Opioid/substance use in pregnancy

The appropriate balance of competing interests between the pregnant individual and the infant is an ethical exercise that is beyond the scope of simulation modeling.

EX 3. Opioid/substance use in pregnancy

Even if buprenorphine is “dominating” in the parlance of decision science and health economics—if requiring this treatment leads to reduced retention—it becomes a poor policy, leading to worse outcomes & higher costs than allowing individuals to CHOOSE their preferred option.

Estimating probabilities is fundamental to decision making

- Cannot readily obtain needed probabilities
- Varying time periods / lengths
- Methods to estimate probabilities

Commonality of cases

- Unavoidable tradeoffs
- Different perspectives may lead to different conclusions
- Multiple competing objectives
- Complexity
- Uncertainty

Decision Analysis

- Aims to inform choice under uncertainty using an explicit, quantitative approach
- Aims to **identify, measure, & value the consequences of decisions under uncertainty** when a decision needs to be made, most appropriately over time.

Workshop Design

1. We're *flexible* – if there is a topic that is unclear to you, or that you would like expanded upon, please let us know!
2. Mixed content
 - Lectures
 - Small group case studies
 - Large group case studies and “hands-on” Excel exercises

Workshop Content

1. Basics of decision analysis (Day 1) • Decision trees

Workshop Content

2. Basics of Cost-Effectiveness Analysis (Days 2-3)

- Valuing cost and health outcomes
- Incremental cost-effectiveness analysis
- Introduction to Markov Modeling

Workshop Content

3. Advanced Topic Preview (4)

- Sensitivity Analysis
- Advanced CEA modeling frameworks.

Questions?

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