Assessing Policy Options Health Impacts

Bloomberg Philanthropies DATA FOR HEALTH INITIATIVE

D2P Data to Policy

CDC Foundation
Together our impact is greater

Vital Strategies

Learning objectives

At the end of this module, you will be able to:

- Model and estimate the health impact of a policy option
- Construct a decision tree
- Identify the information needed to use the model

Review & preview

- **Last lecture:**

  How to frame an economic evaluation?

- **This lecture:**

  Health impact of a program (or policy option): Does it have a meaningful health impact?

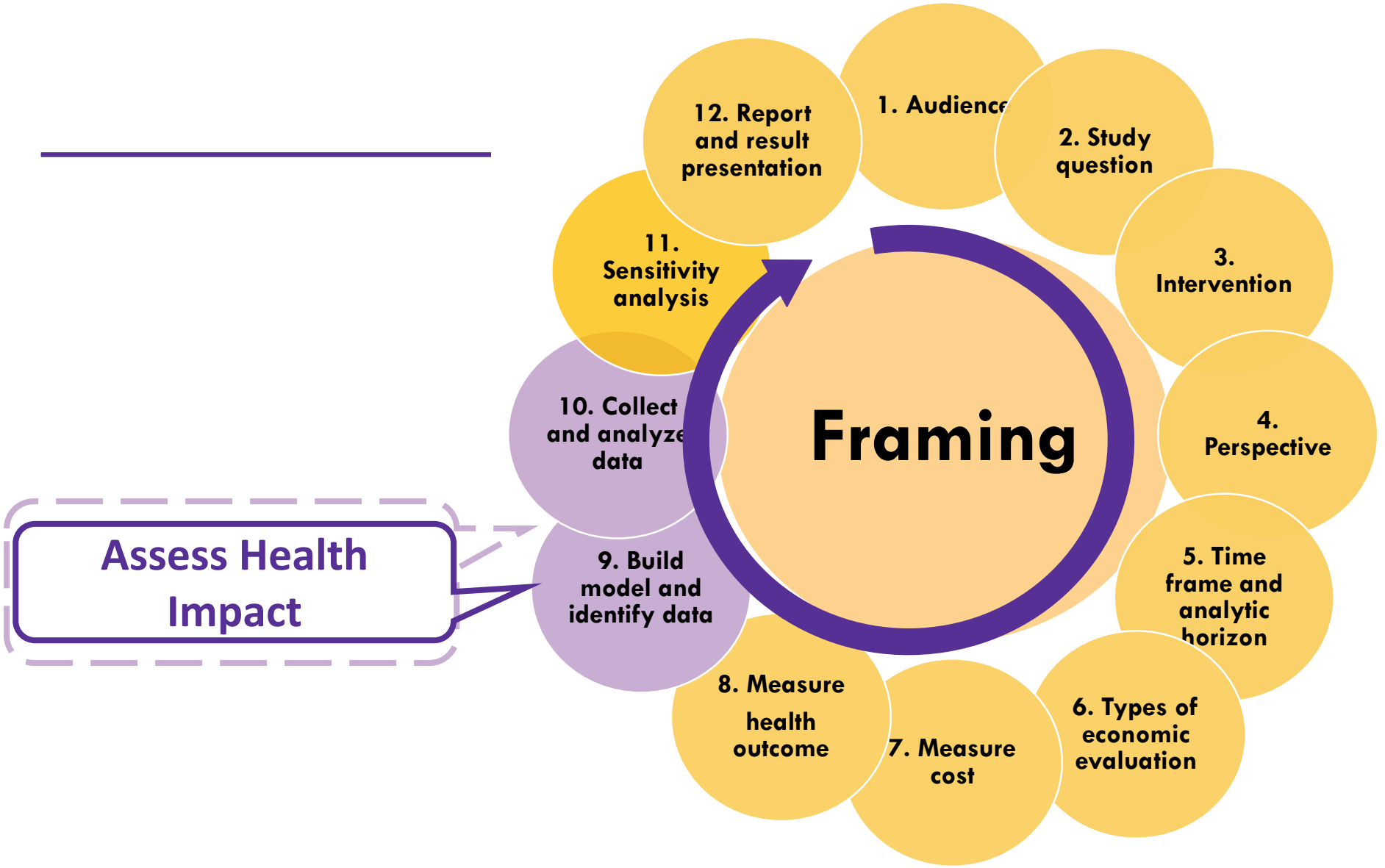
- **Next lecture:**

  Can you afford the intervention (policy option)?

Three questions decision makers ask:

1. **How big is the problem?**
2. **What can we do about it?**
   - What interventions do we have to address the problem?
   - Which intervention has the most impact?
3. **How much will it cost?**
   - What resources are required to address the problem?
   - Do we have enough resources (ex: people, supplies, equipment, time)?

Models can help estimate the impact of interventions


Framing
1. Audience
2. Study question
3. Intervention
4. Perspective
5. Time frame and analytic horizon
6. Types of economic evaluation
7. Measure cost
8. Measure health outcome
9. Build model and identify data
10. Collect and analyze data
11. Sensitivity analysis
12. Report and result presentation
Assess Health Impact

Why use models?

- **Models help (economic and health futures, etc.), when we:**
  - Have limited epidemiologic data and need to fill in gaps
  - Want to evaluate answers to “intuition” and “what if” analyses (such as new vaccine) before committing
- **Ebola example (2014, West Africa)**
  - Few data available early during epidemic
  - Modeling used to estimate that without interventions, 1.4M people would contract Ebola, while specific interventions could reduce ~10,000 cases
  - Led to ~$2B in funding sent to region to intervene

Need data to support intervention proposal

- **Proposed intervention:** Screen and treat pregnant women for syphilis, in Philippines

  How convincing is this proposed intervention?

- **Data supporting the effectiveness of this option:**
  - In the Philippines, 15% of pregnant women are infected with syphilis
  - Early antibiotic treatment for syphilis during pregnancy can prevent nearly all syphilis-associated adverse outcomes (including perinatal deaths)
- **Is this sufficient information to argue for screen and treat option?**

  What about the effect of screen and treat option on perinatal deaths, the outcome of interest?

- **More data:**
  - Screen and treat program implementation is estimated to prevent 400 infant deaths each year
  - A similar program in Mozambique effectively prevented congenital syphilis at $50 per case

Health impact estimation

Use data to project **changes in health outcomes** from a **proposed intervention,** based on the **specific situation** in which the intervention will be implemented.

Tools to evaluate proposed intervention

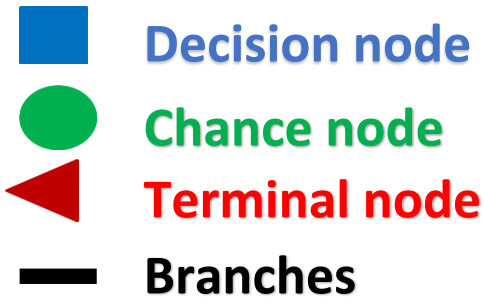
- **Many tools exist to model and evaluate interventions**
- **Evaluation tool is chosen based on:**
  - Available software
  - Data
  - Output
  - Potential use i.e. will others be able to use and access the tool as well?

Simple and accessible is often the right option - for broader use!

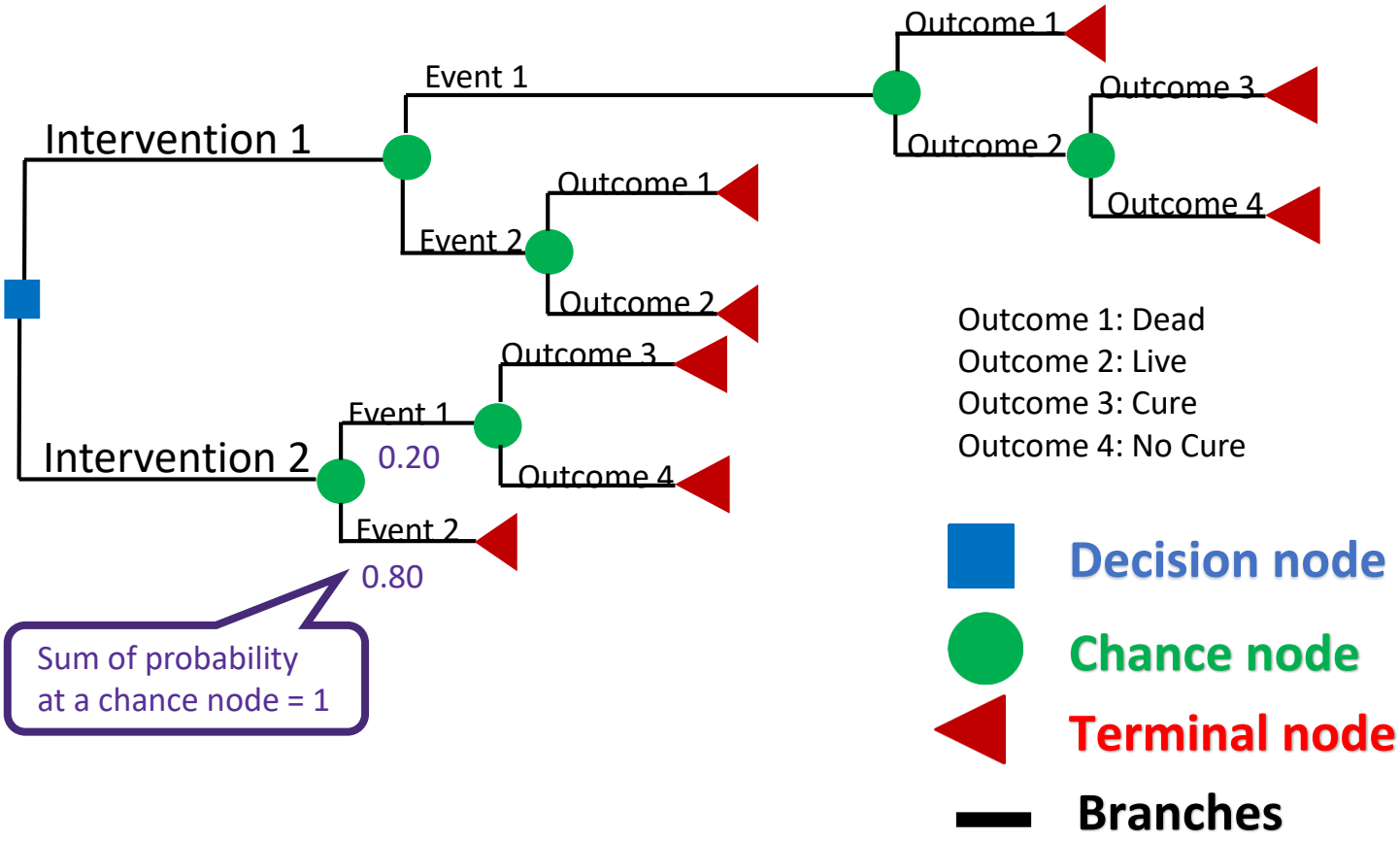
We primarily focus on decision trees, which require no special tech

What is a decision tree?

- **Systematic visual representation of decisions, processes, and outcomes**
  - Each decision point splits off until you reach the outcome
- **Compares expected outcomes of various intervention options**
  - Uses probabilities
  - Enables selection of most effective option
- **Decision tree components:**



What are the elements of a decision tree's structure?


Intervention 1
Event 1
Outcome 1
Outcome 3
Outcome 2
Outcome 4
Outcome 1
Event 2
Outcome 2
Outcome 3
Event 1
Intervention 2
0.20
Outcome 4
Event 2
0.80
Sum of probability at a chance node = 1
Outcome 1: Dead
Outcome 2: Live
Outcome 3: Cure
Outcome 4: No Cure
Decision node
Chance node
Terminal node
Branches

Decision tree steps

1. Identify and describe decision problem
2. Identify interventions
3. Identify events/choices within each intervention
4. Fill in each node probability
5. Calculate expected value of interve
6. Choose intervention with best expe

THIS LECTURE

LECTURE 11

Syphilis Example Decision Tree

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Syphilis intervention example

- **In rural Philippines, syphilis in pregnant women accounts for many adverse pregnancy outcomes**
- **Group of antenatal clinics (n=5) in a high-burden rural area are trying to decide if they should screen and treat pregnant women for syphilis**
  - Option 1. Not screen or treat pregnant women (status quo)
  - Option 2. To screen and treat and require $3 from patient
  - Option 3. Treat without screening & require $3 from patient
- **Which option to choose?**

Option 2 v. Option 1

Proposed screen & treat program information

- 100% of pregnant women in catchment area receive prenatal care at least once during their pregnancies from the ANC clinics proposing the program
- **Proposed program:**
  - Participating clinics offer waiting room educational materials on congenital syphilis and benefits of treatment
  - At first antenatal care visit, women can opt to receive screening and treatment for $3 from patient
  - Those who opt in will receive point-of-care testing
  - Women testing positive receive immediate treatment, counseling, and take-home treatment for one partner

Step 1: Describe decision problem

- **What is the population (and size) targeted by the intervention?**
  - Pregnant women in catchment area who use the clinics
- **What health outcome will we be evaluating?**
  - Perinatal mortality (fetal loss, stillbirth, neonatal mortality)
  - ~37% of pregnancies in mothers with untreated syphilis
- **What are the program priorities?**
  - Minimize cost
  - Maximize benefit (i.e., minimize perinatal deaths)
  - A combination of both

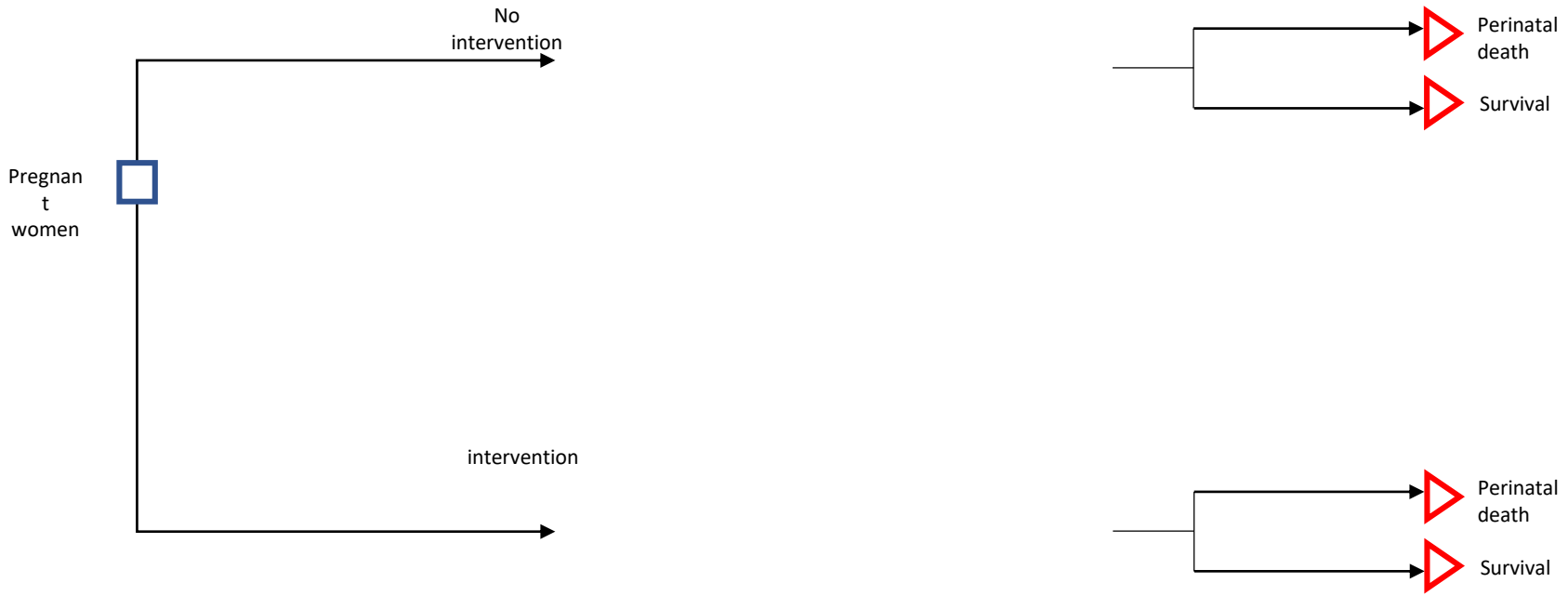
Put population and outcomes in decision tree

- **Population – all pregnant women served by clinics**
- **Health outcomes (terminal nodes)**
  - Perinatal death
  - Survival

Step 2: Identify the interventions

- List main intervention (or policy options) being compared
- At least two options, here:
  - Option 1: Not screen or treat pregnant women (status quo)
  - Option 2: To screen and treat and require $3 from patient

Put interventions in decision tree



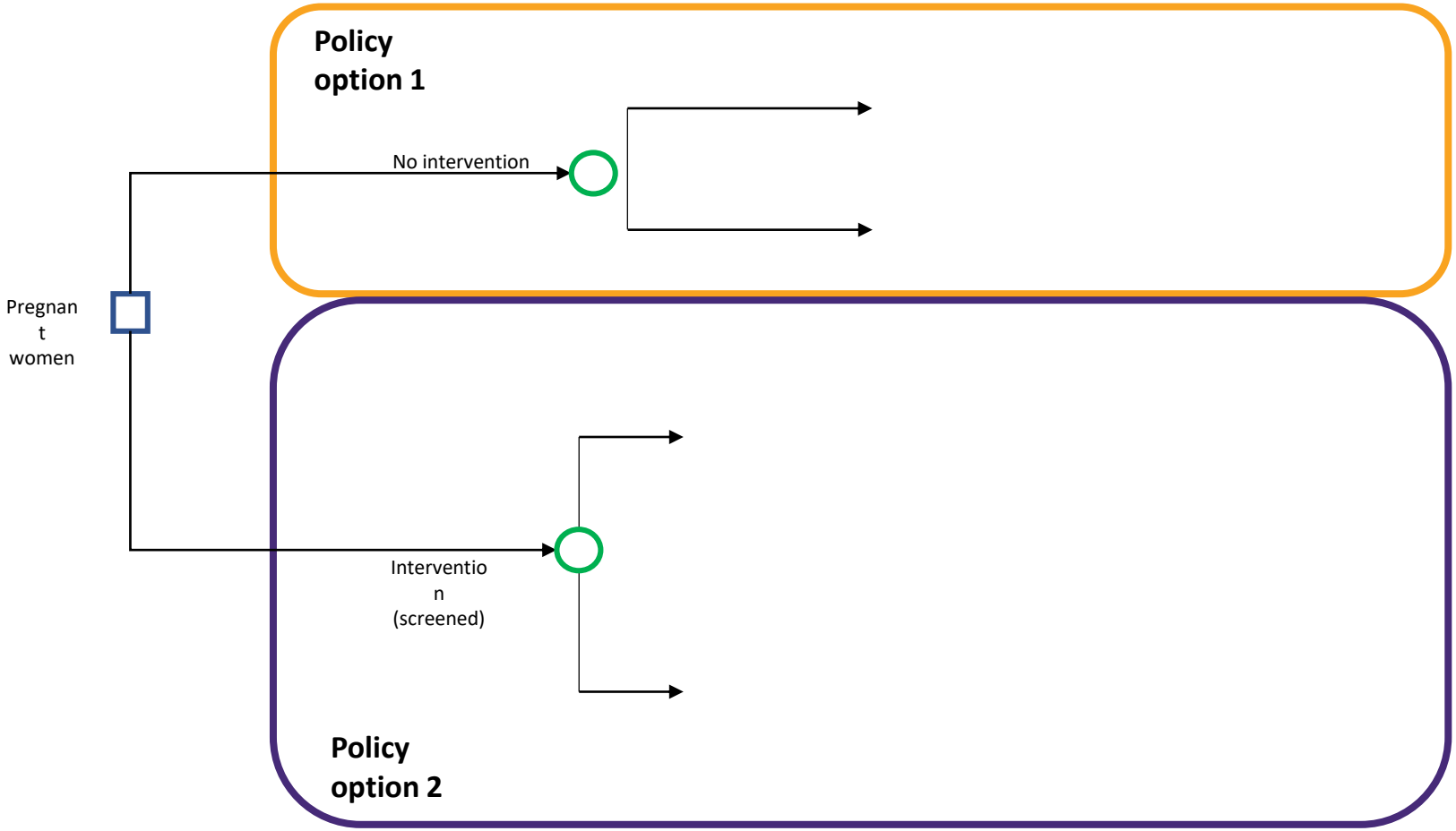
Step 3: Identify choices within each intervention

What are the steps in ***each intervention*** after the decision node?

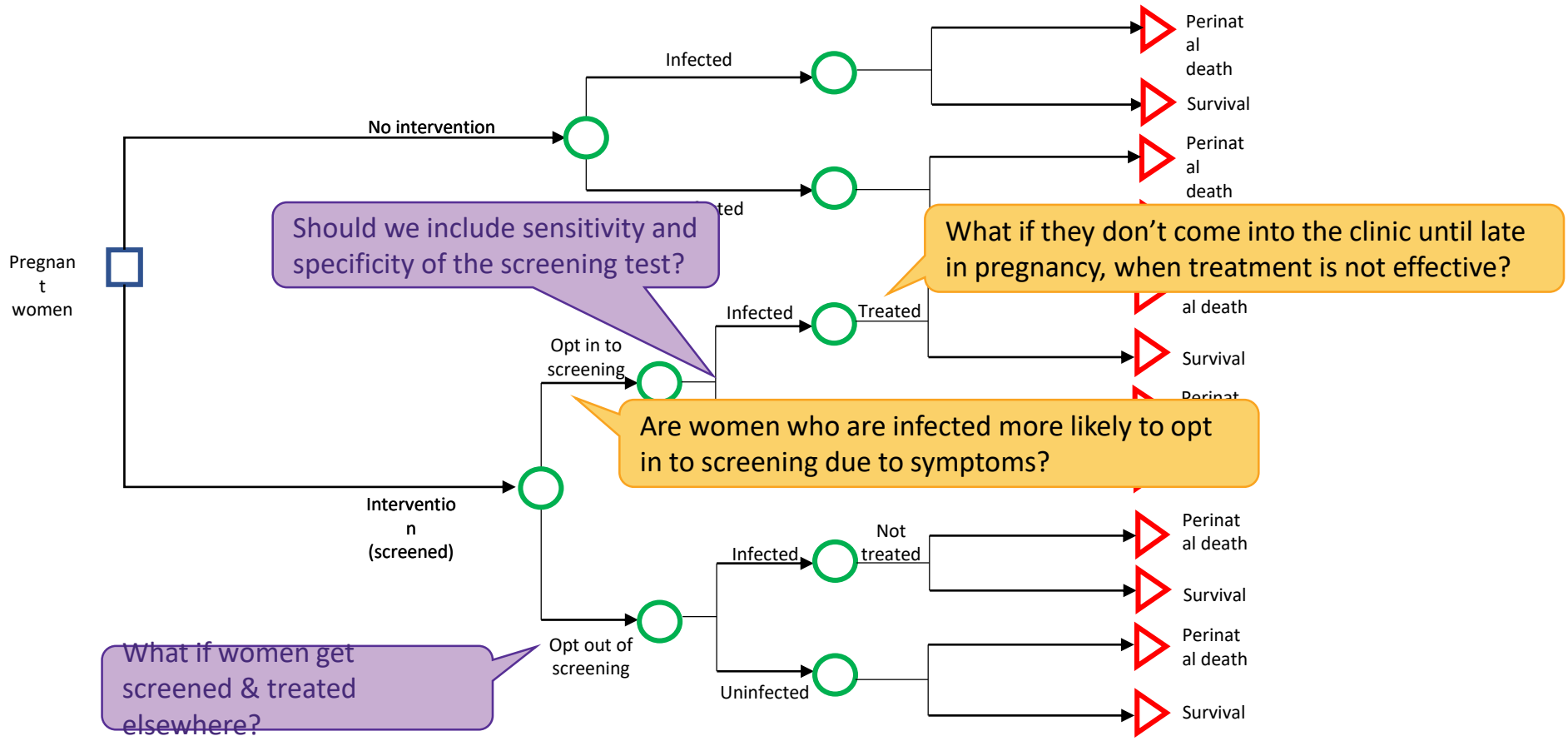
- Consider each intervention option separately
- Likely to be different steps after each option!

Syphilis examples, choices for each intervention

- Opt in to screening (v. opting out)
- Infected with syphilis (v. uninfected)
- Perinatal death (v. survival), given infection status


Policy
option 1
No intervention
Pregnan
t
women
Interventio
n
(screened)
Policy
option 2

Simple vs. Complex



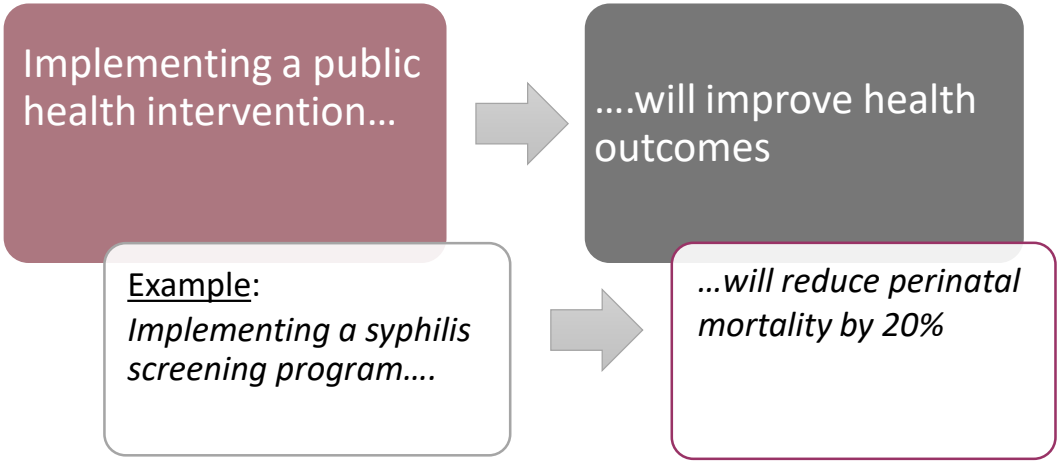
No model is perfect: state assumptions upfront

- If women are not screened and treated at these clinics, they won't be screened or treated elsewhere **Probably Not!**
- All women will present early enough during their pregnancy for perinatal death to be avoided due to syphilis
- Sensitivity and specificity of the test are high enough to not include in model (Best rapid syphilis tests have sensitivity & specificity > 90%)

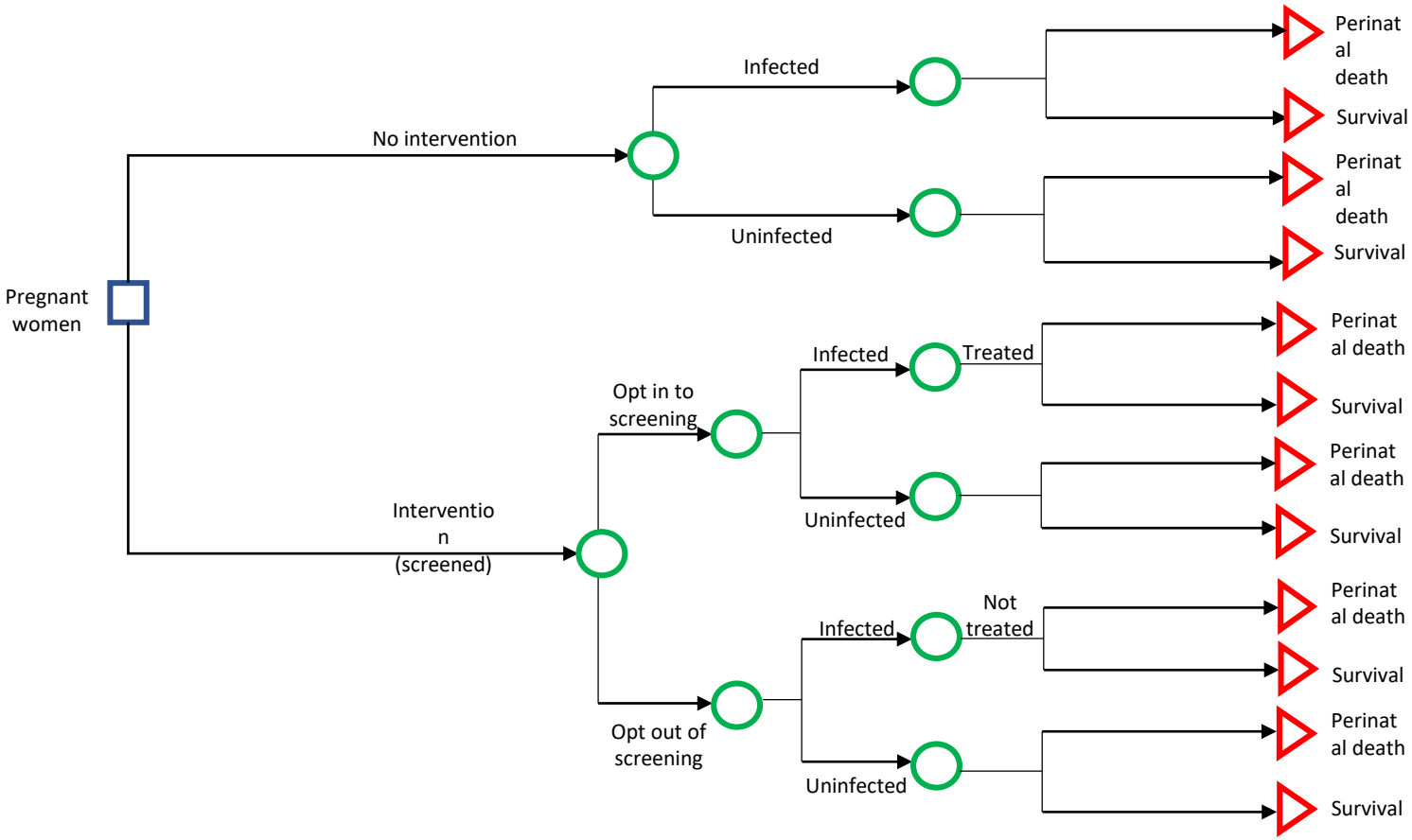
Even likely wrong assumptions SHOULD BE INCLUDED as decision tree branches.

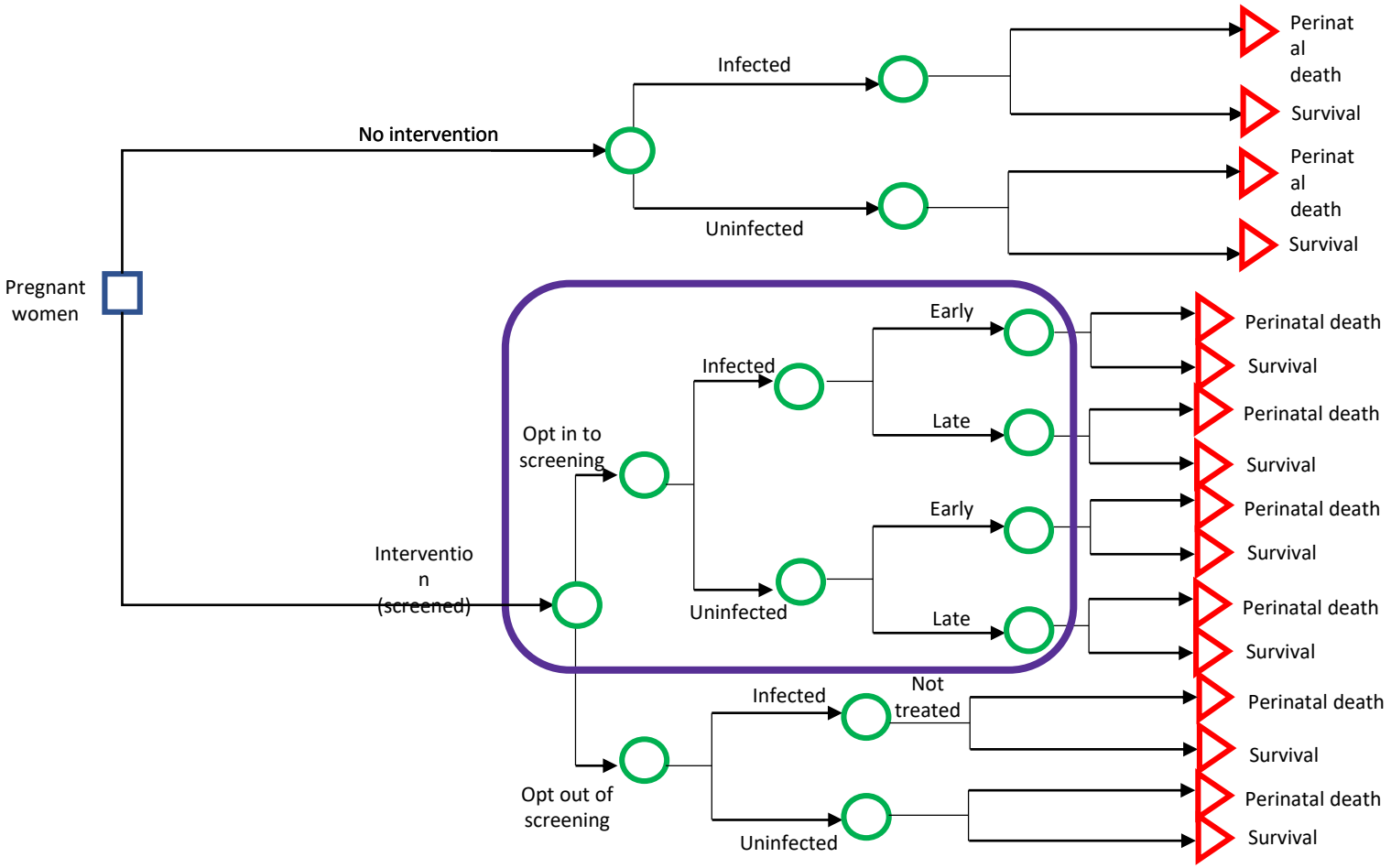
Assumptions are not made to make model easy – Assumptions are realistic ideas.

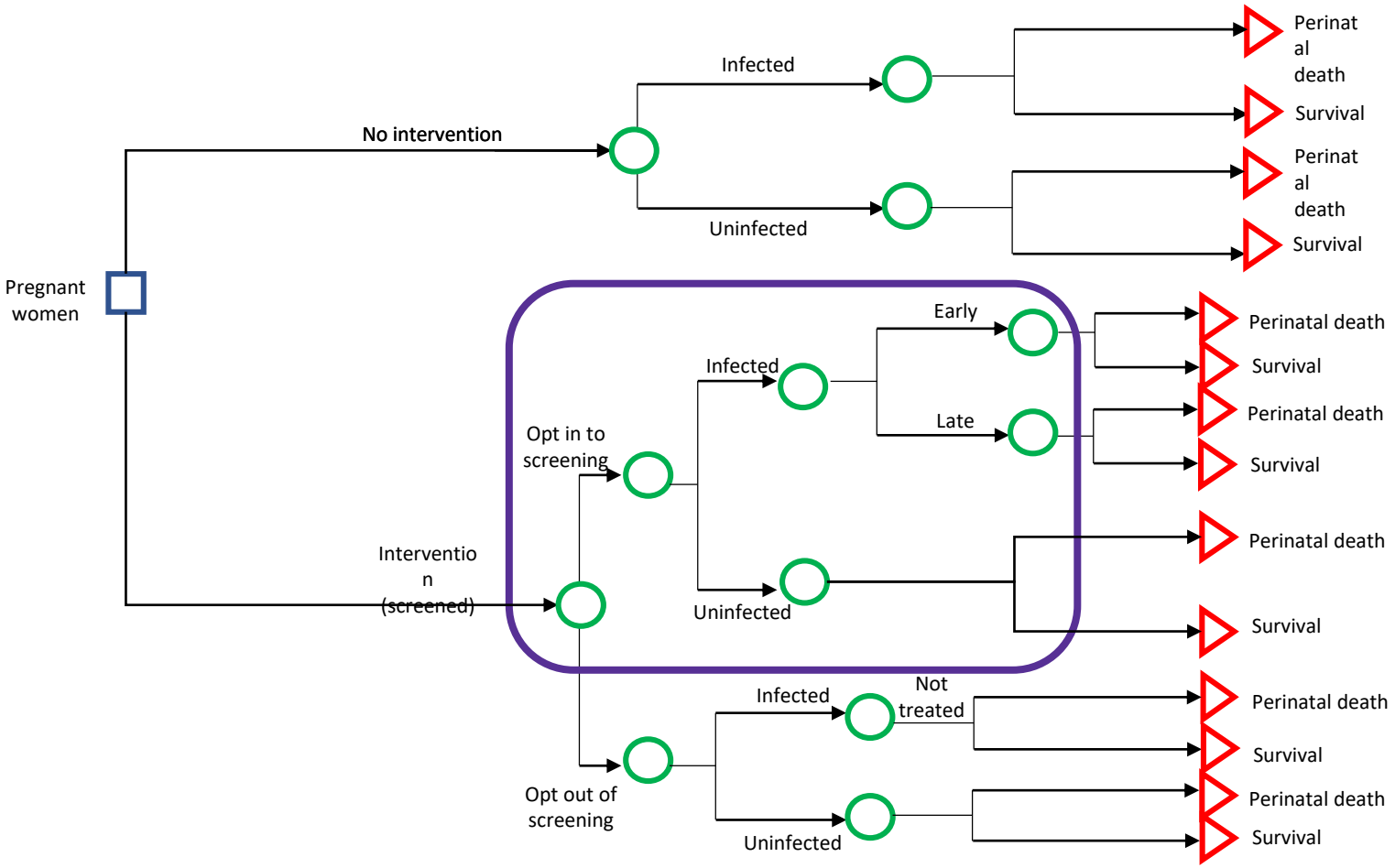
All models are wrong, but some models are useful – George Box

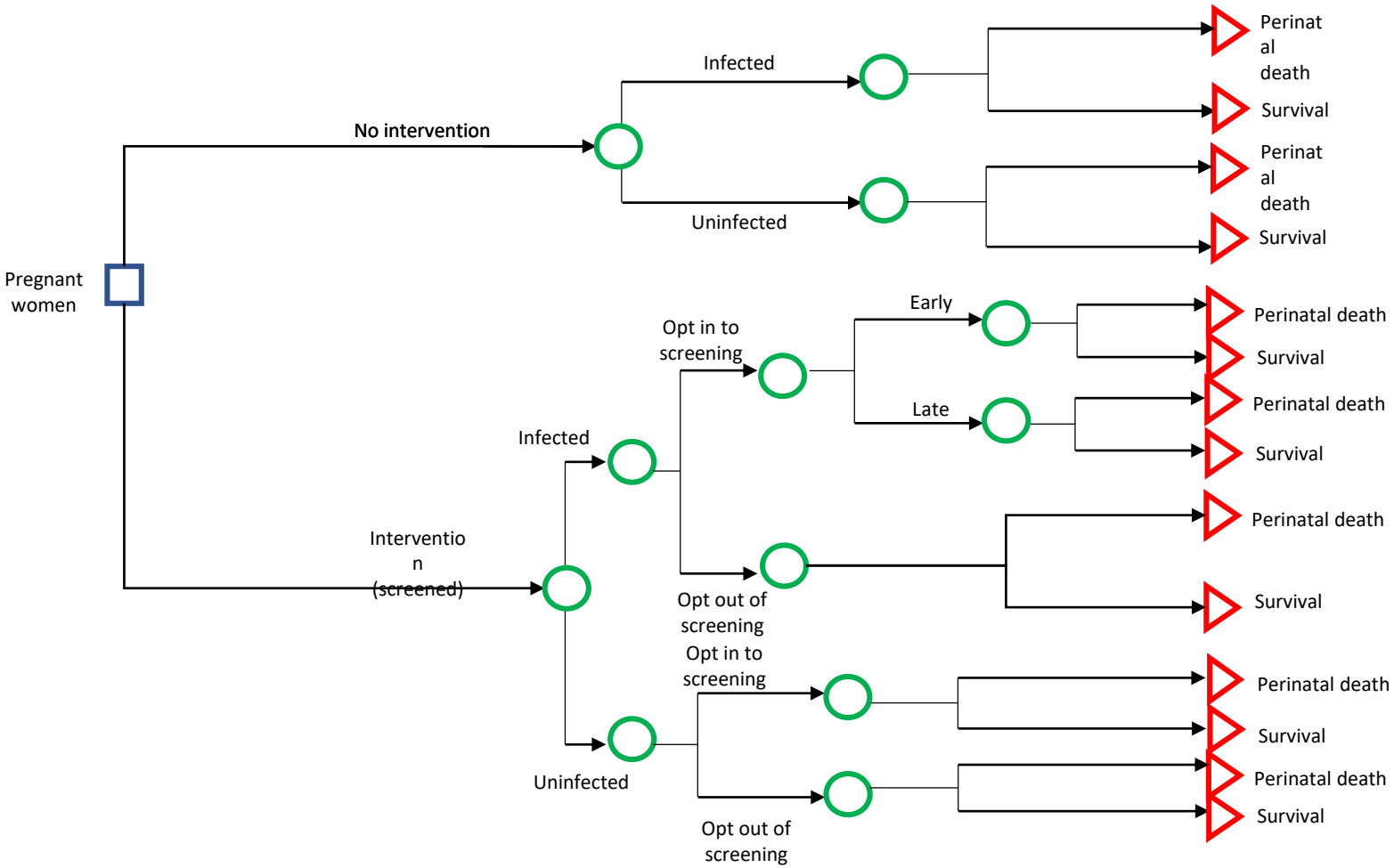


A simple model


Pregnant women
No intervention
Infected
Perinatal death
Survival
Uninfected
Perinatal death
Survival
Intervention (screened)
Opt in to screening
Infected
Treated
Perinatal death
Survival
Uninfected
Perinatal death
Survival
Opt out of screening
Infected
Not treated
Perinatal death
Survival
Uninfected
Perinatal death
Survival


Pregnant women
No intervention
Infected
Uninfected
Perinatal death
Survival
Perinatal death
Survival
Intervention (screened)
Opt in to screening
Infected
Uninfected
Early
Late
Early
Late
Perinatal death
Survival
Perinatal death
Survival
Perinatal death
Survival
Perinatal death
Survival
Opt out of screening
Infected
Uninfected
Not treated
Perinatal death
Survival
Perinatal death
Survival


Pregnant women
No intervention
Infected
Uninfected
Perinatal death
Survival
Perinatal death
Survival
Intervention (screened)
Opt in to screening
Infected
Early
Late
Uninfected
Perinatal death
Survival
Perinatal death
Survival
Opt out of screening
Infected
Not treated
Uninfected
Perinatal death
Survival
Perinatal death
Survival


Pregnant women
No intervention
Infected
Perinatal death
Survival
Uninfected
Perinatal death
Survival
Intervention (screened)
Infected
Opt in to screening
Early
Perinatal death
Survival
Late
Perinatal death
Survival
Opt out of screening
Perinatal death
Survival
Uninfected
Opt in to screening
Perinatal death
Survival
Opt out of screening
Perinatal death
Survival

Step 3: Identify choices within each intervention

- There is usually more than one way to build a tree
  - Complexity
  - Outcomes
  - Available data
  - The way you think
- Usually won’t get it “right” the first time!

Decision tree steps

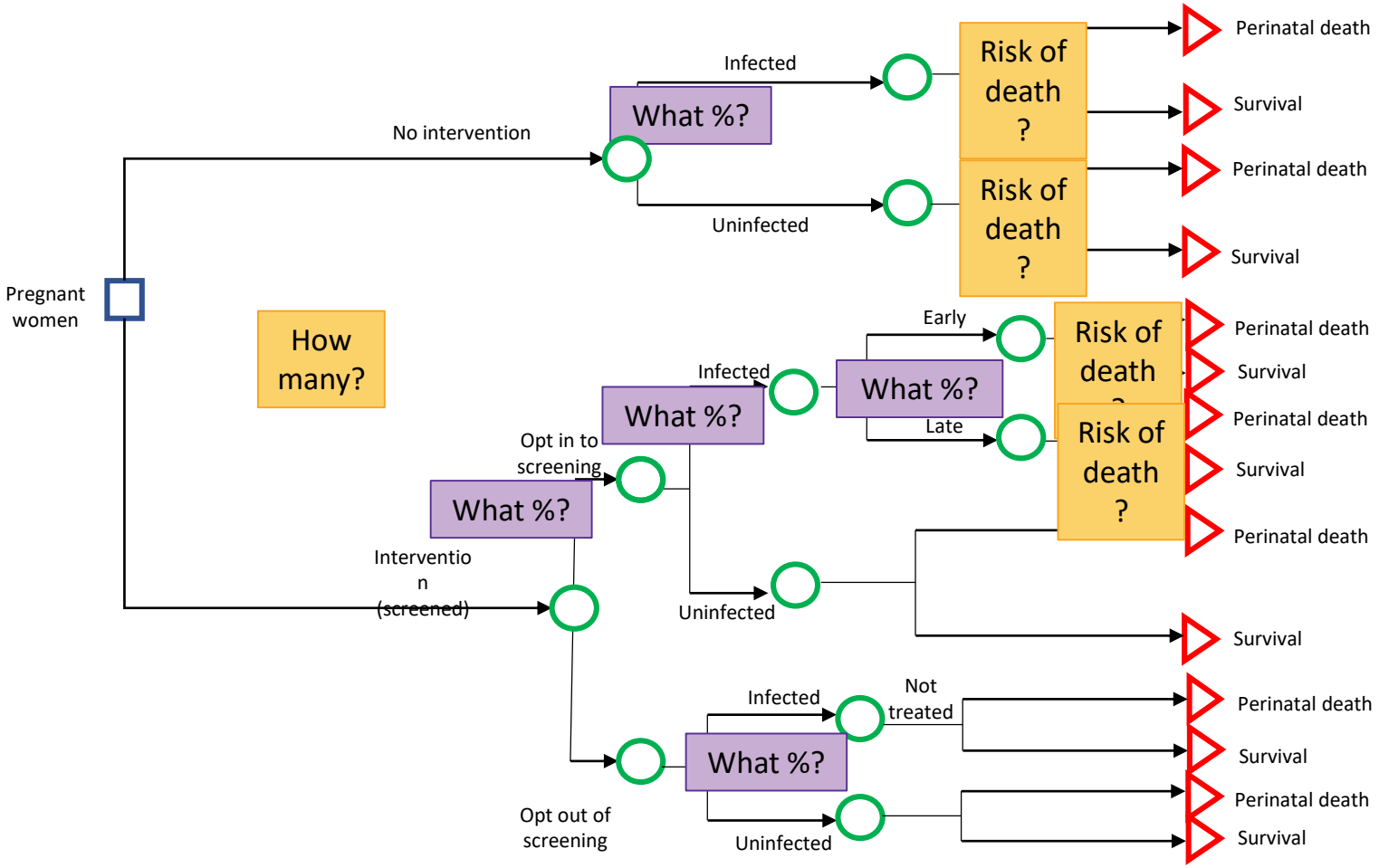
1. Identify and describe decision problem
2. Identify interventions
3. Identify events/choices within each intervention
4. Fill in each node probability
5. Calculate expected value of intervention
6. Choose intervention with best expected value

Completed so far

Additional commonly needed data

- **Size of population of interest (target population for intervention)**
- **Baseline incidence or prevalence of condition (burden)**
- **Costs at baseline for treatment per prevention**
- **Conditional probabilities (relative risks, odds ratios) of outcomes given certain decision points**

  e.g., chance of testing positive, given screening


Pregnant women
How many?
No intervention
What %?
Infected
Uninfected
Risk of death ?
Risk of death ?
Perinatal death
Survival
Perinatal death
Survival
Opt in to screening
What %?
Intervention (screened)
What %?
Infected
Uninfected
Early
Late
What %?
Risk of death ?
Risk of death ?
Perinatal death
Survival
Perinatal death
Survival
Perinatal death
Survival
Opt out of screening
What %?
Infected
Uninfected
Not treated
Perinatal death
Survival
Perinatal death
Survival

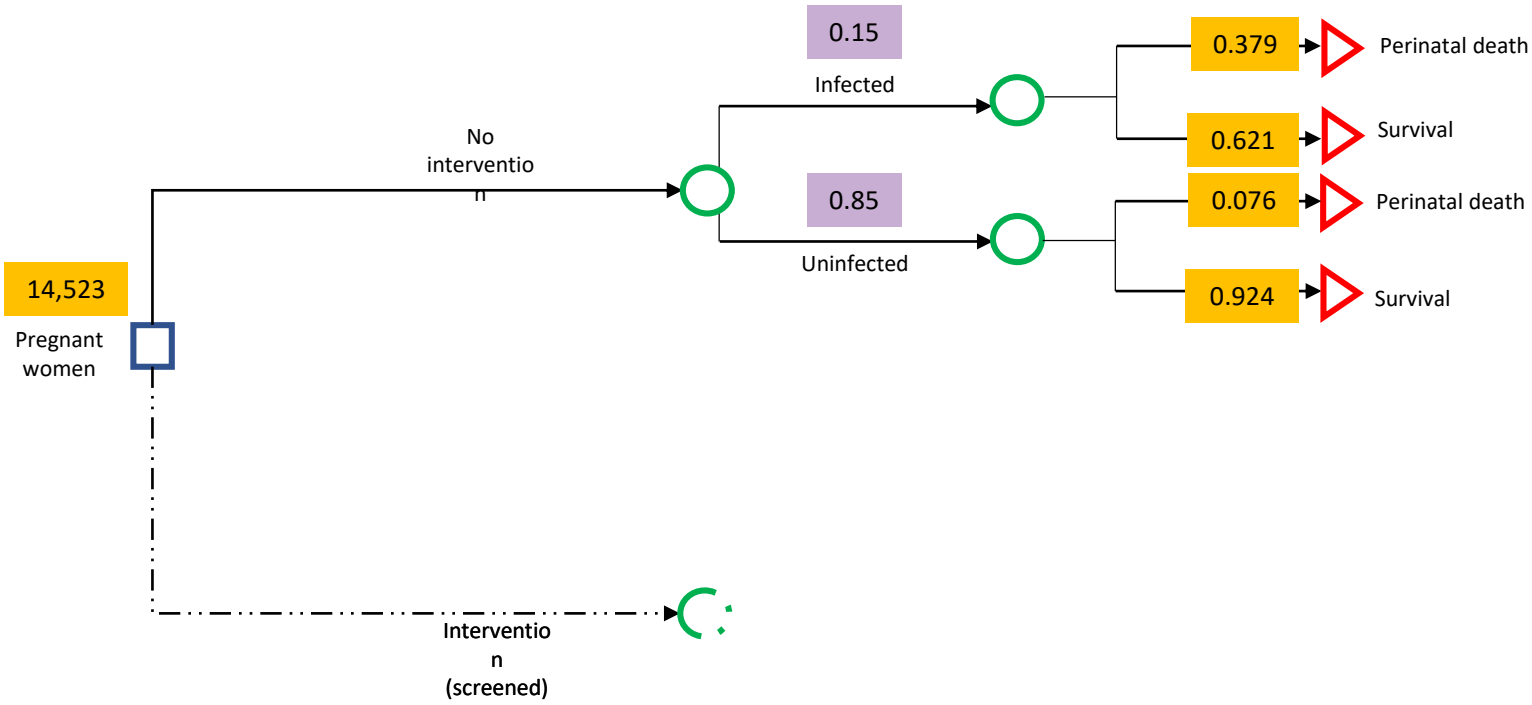
Populate model with data

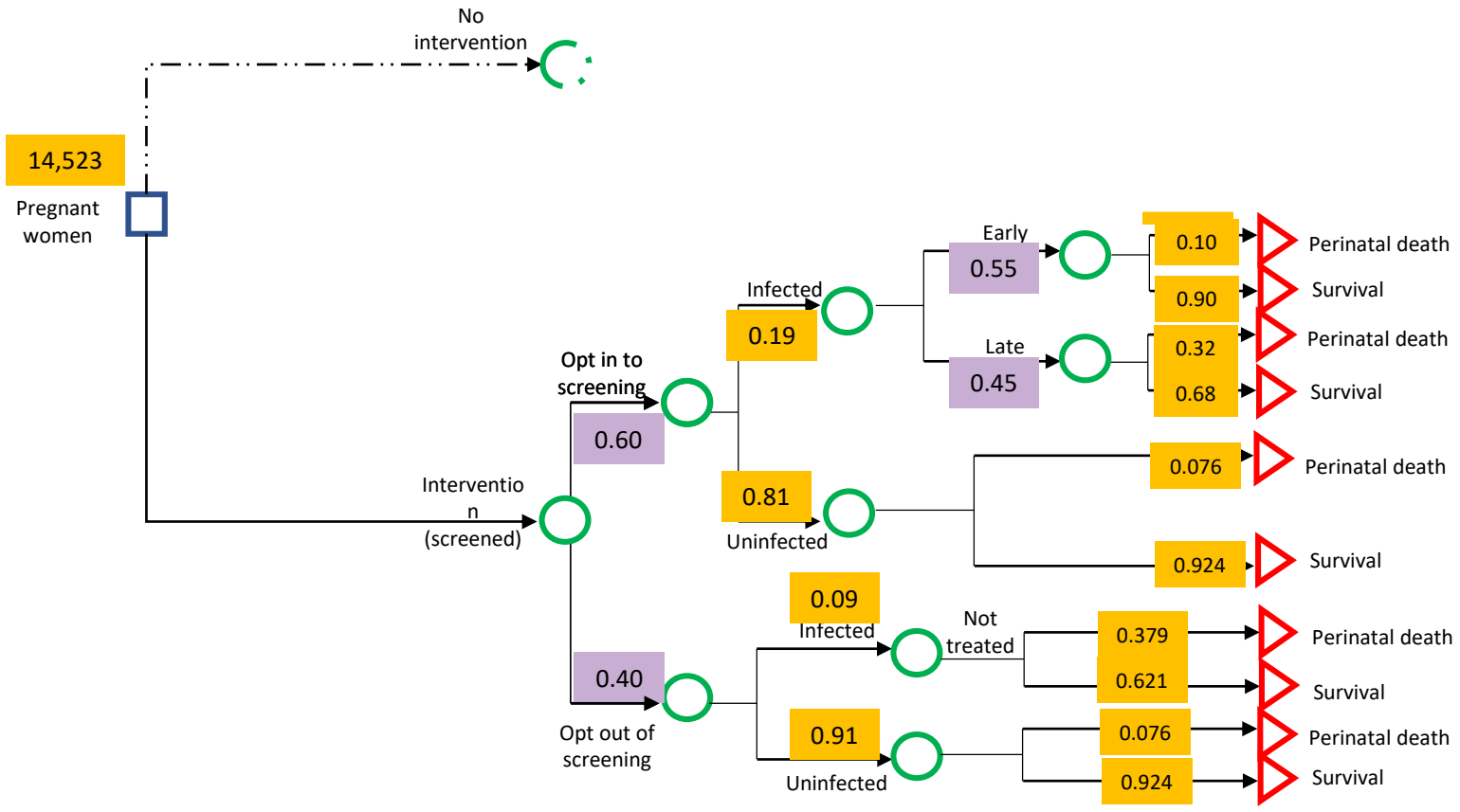
- **Sources of data**
  - Data from the literature
  - Analyses from national or local data
  - Expert opinions
  - Your best guess!

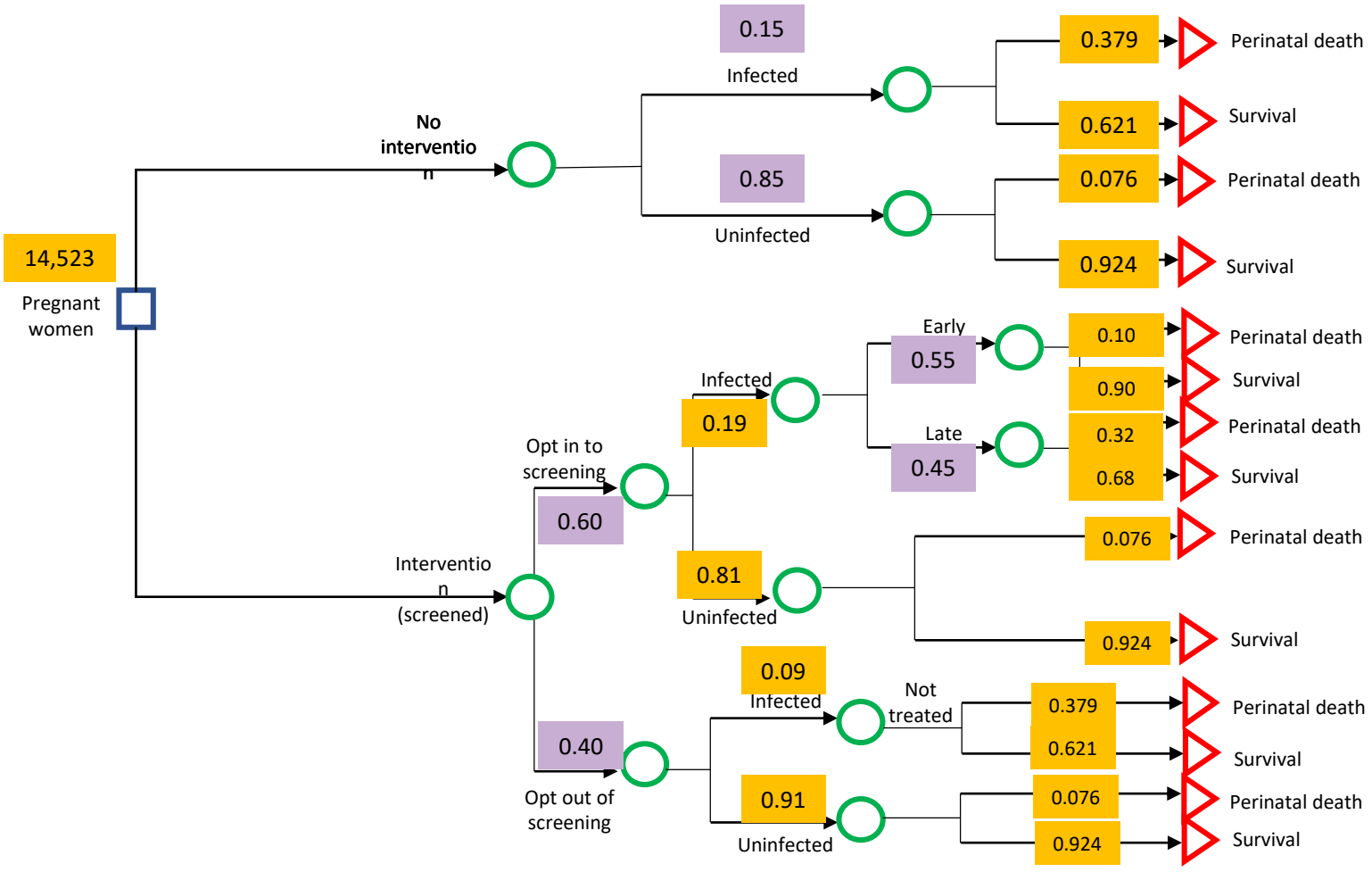
- **Levels of certainty**
  - You will not feel equally certain about each data point!
  - Prioritize evidence-based estimates
  - Don’t be afraid to use your best guess if no data are available

Data for syphilis model

Variables	Value	Source
Population attending antenatal clinics in one year	14,523	Annual clinic data
Proportion who opt in to screening with $3 copay	60%	Similar policies, other places
Overall prevalence of infection in pregnant women	15%	MOH data
Prevalence of infection among women who opt in to screening	19%	Based on programs in other countries
Prevalence of infection among women who opt out of screening	9%	Based on programs in other countries
Proportion of women who present early	55%	Annual clinic data
Perinatal mortality in uninfected women	7.6%	Literature
Perinatal mortality in infected, untreated women	37.9%	Literature
Perinatal mortality in infected, treated women who present early	10.0%	Literature
Perinatal mortality in infected, treated women who present late	32.0%	Literature


14,523
Pregnant women
No intervention
Intervention (screened)
0.15
Infected
0.85
Uninfected
0.379
Perinatal death
0.621
Survival
0.076
Perinatal death
0.924
Survival


No intervention
14,523
Pregnant women
Intervention (screened)
Opt in to screening
0.60
Opt out of screening
0.40
Infected
0.19
Uninfected
0.81
Early
0.55
Late
0.45
0.10
Perinatal death
0.90
Survival
0.32
Perinatal death
0.68
Survival
0.076
Perinatal death
0.924
Survival
0.09
Infected
Not treated
0.379
Perinatal death
0.621
Survival
0.91
Uninfected
0.076
Perinatal death
0.924
Survival


14,523
Pregnant women
No intervention
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Infected
0.85
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0.379
Perinatal death
0.621
Survival
0.076
Perinatal death
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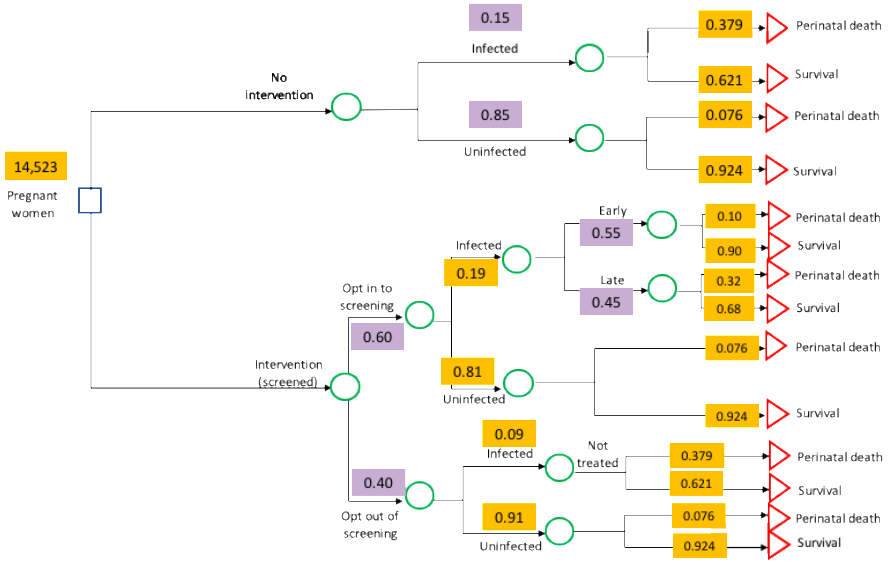
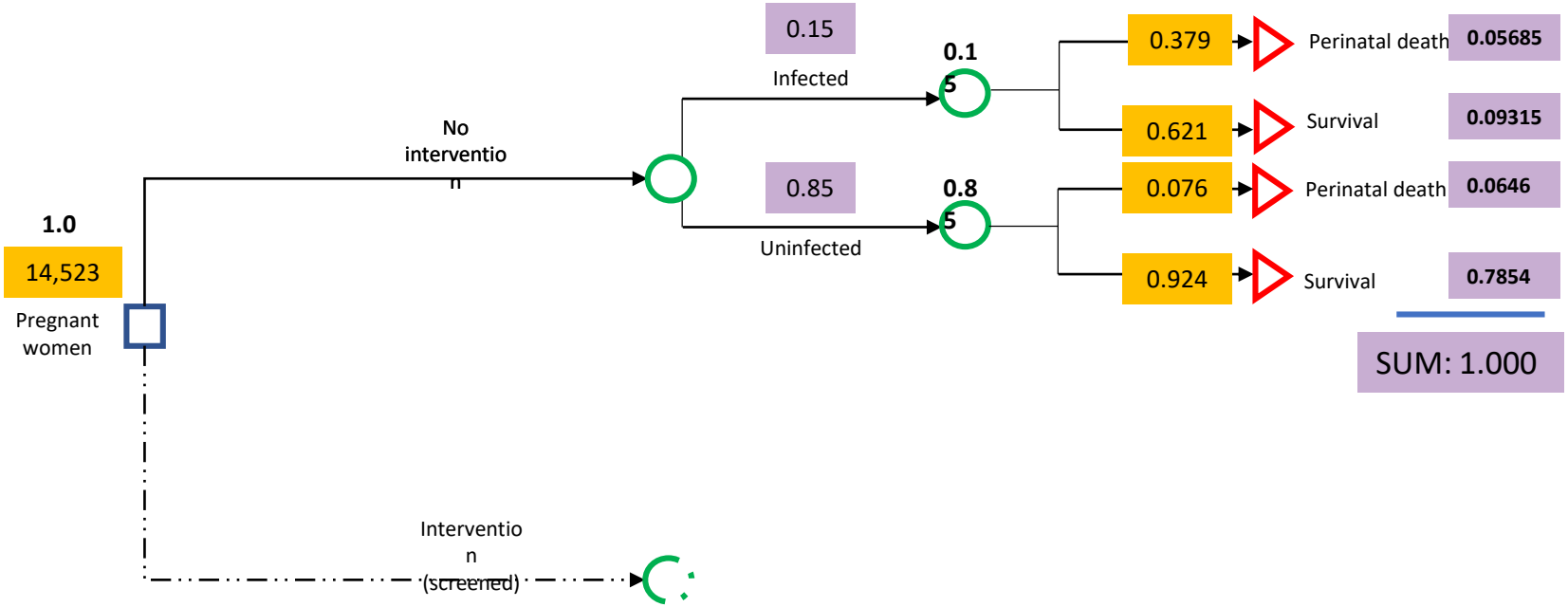
Survival
Intervention (screened)
Opt in to screening
0.60
Infected
0.19
Early
0.55
Late
0.45
0.10
Perinatal death
0.90
Survival
0.32
Perinatal death
0.68
Survival
0.81
Uninfected
0.076
Perinatal death
0.924
Survival
0.40
Opt out of screening
0.09
Infected
Not treated
0.379
Perinatal death
0.621
Survival
0.91
Uninfected
0.076
Perinatal death
0.924
Survival

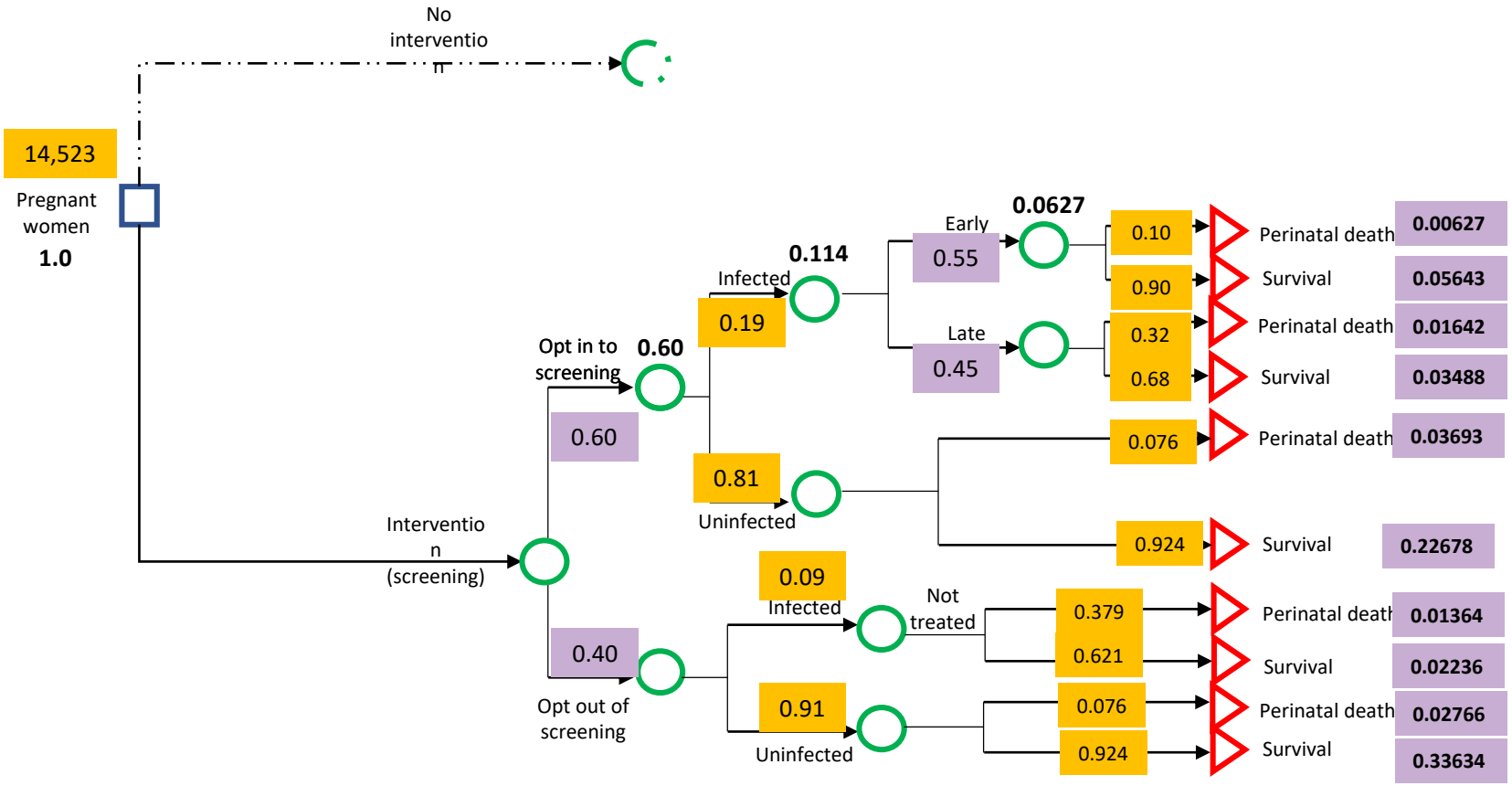
Running the model

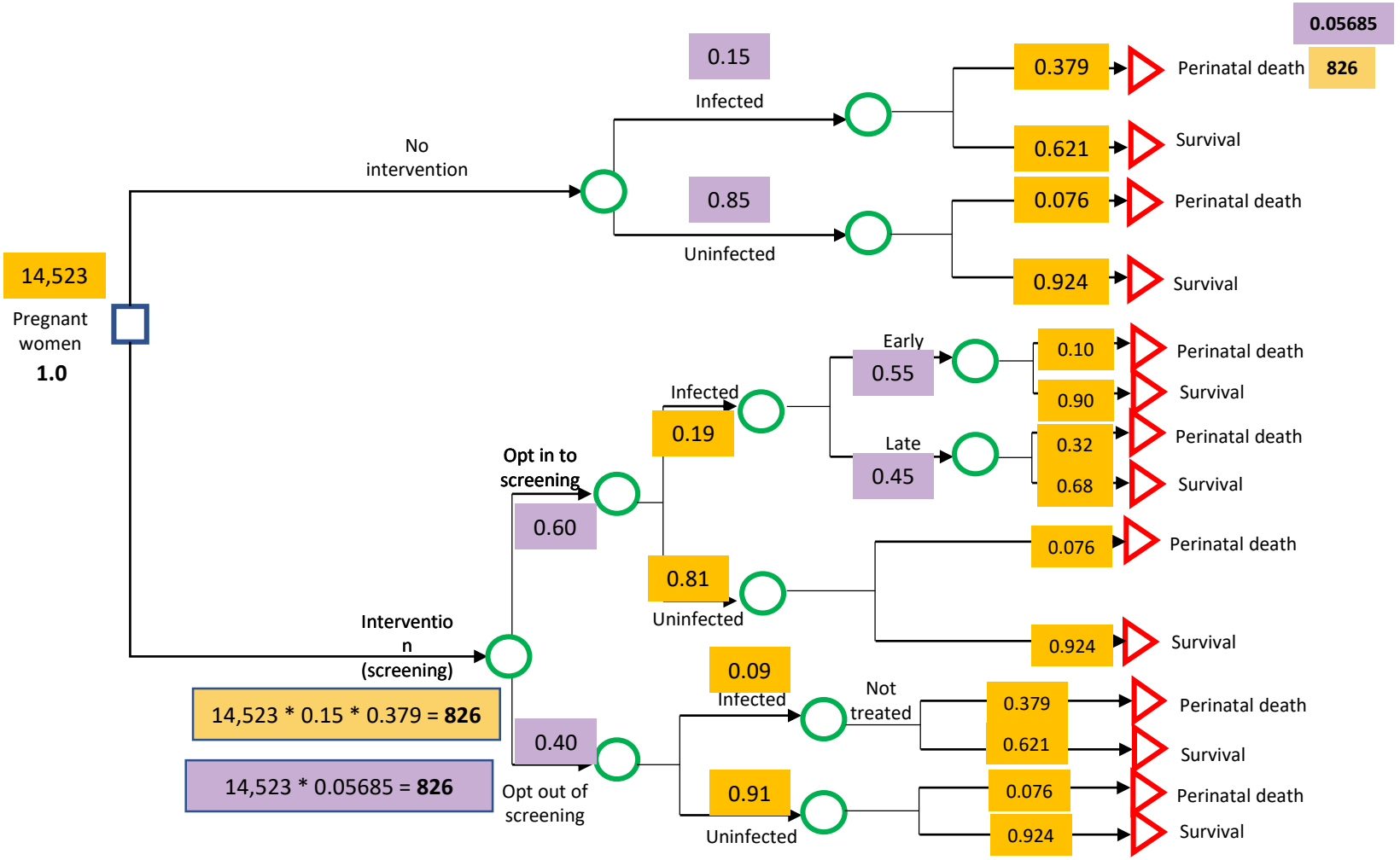
- **Refers to determining the final proportion or count of persons in each group on the far-right of the tree**

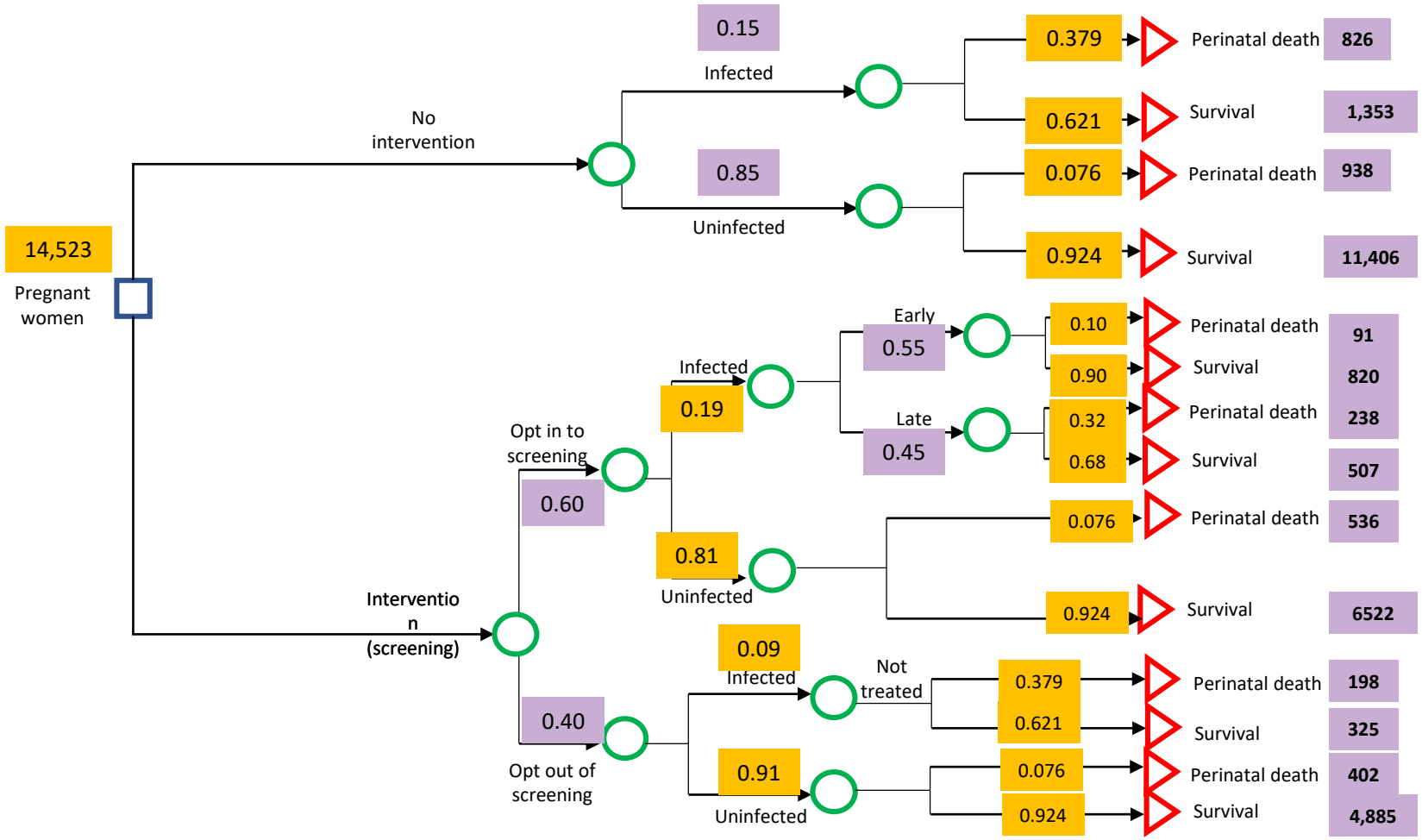


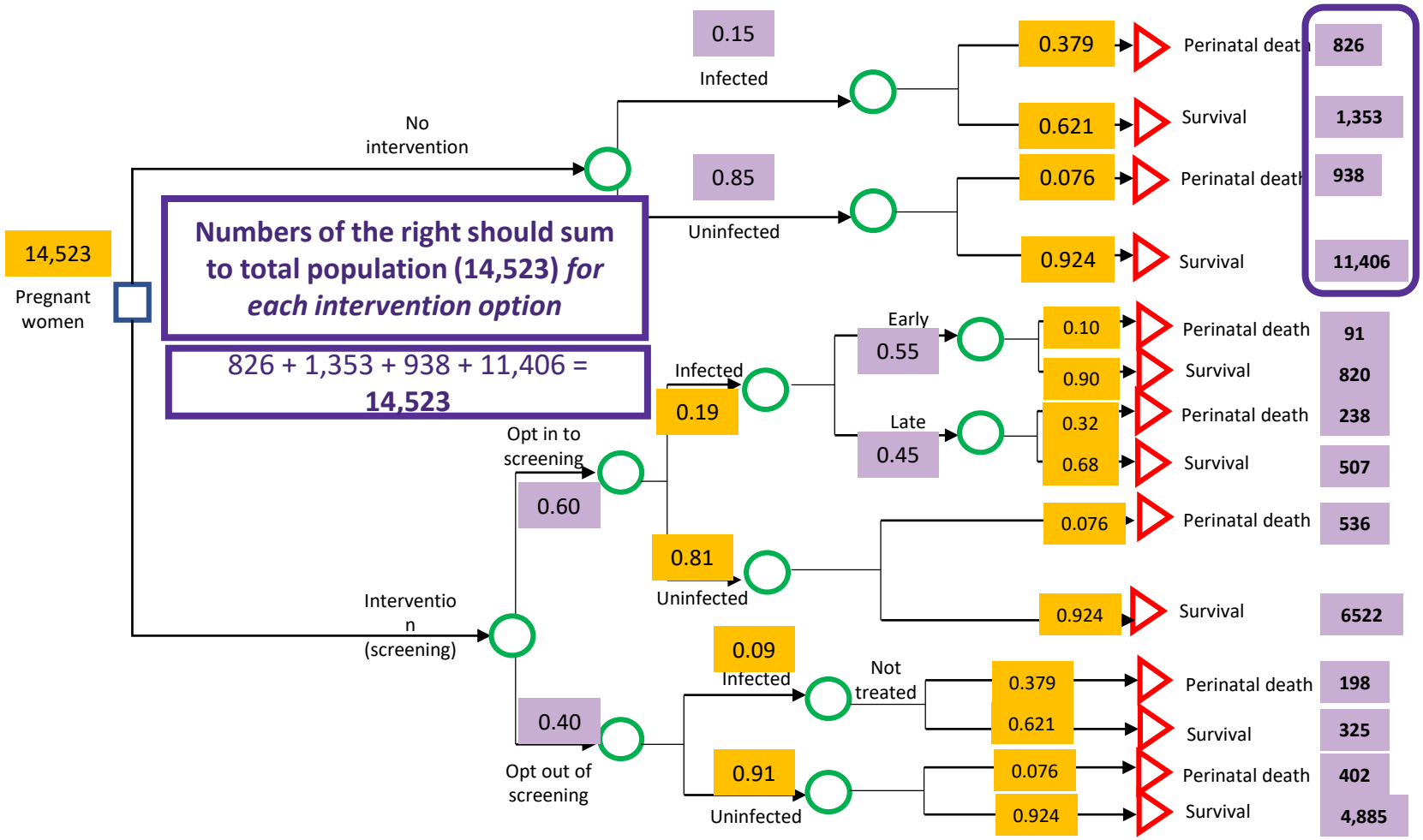
Of total population affected by the intervention, what % or # have each outcome?

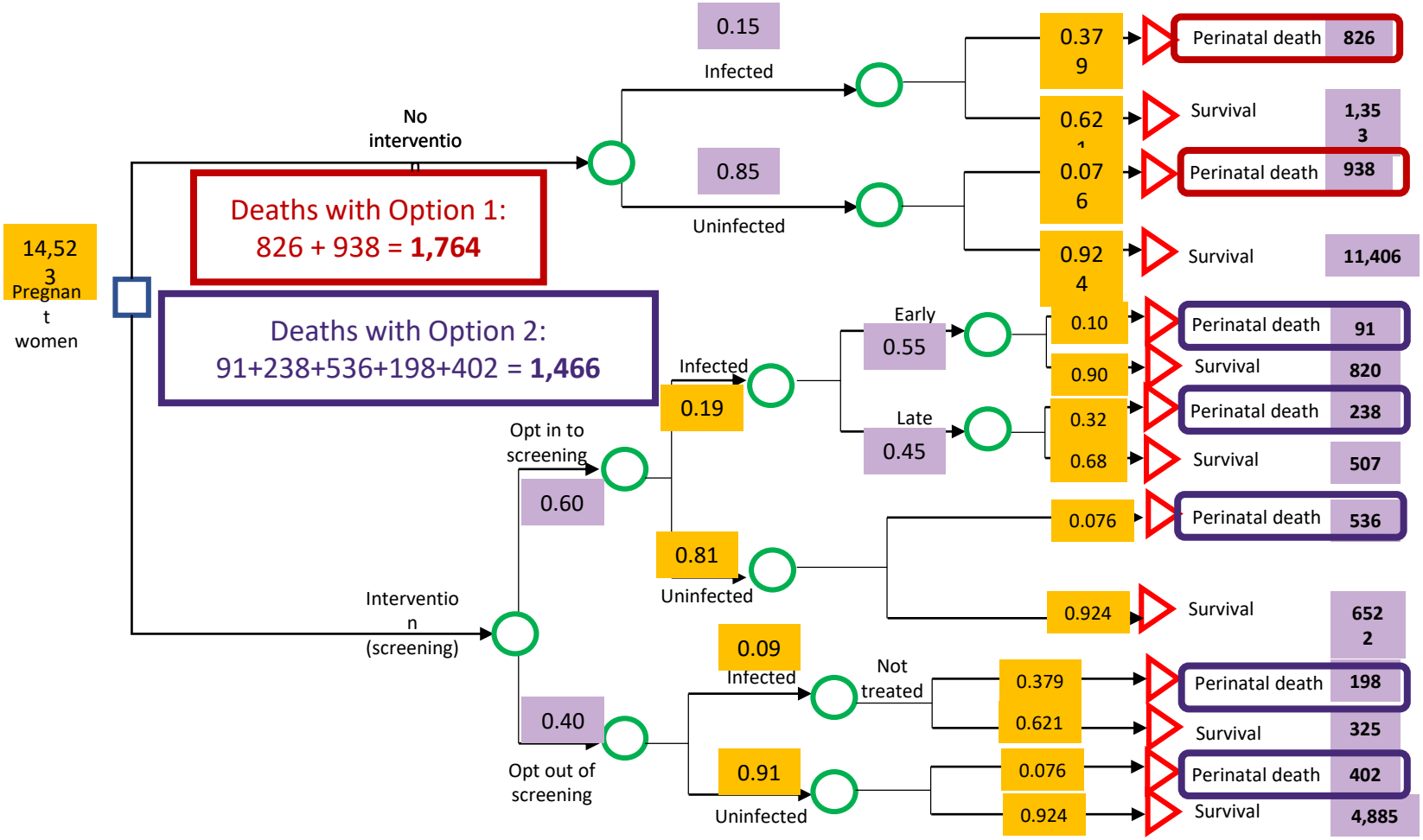

1.0
14,523
Pregnant women
No intervention
Intervention (screened)
0.15
Infected
0.85
Uninfected
0.1
5
0.8
5
0.379
Perinatal death
0.05685
0.621
Survival
0.09315
0.076
Perinatal death
0.0646
0.924
Survival
0.7854
SUM: 1.000


No interventio n
14,523
Pregnant women
1.0
Interventio n (screening)
Opt in to screening
0.60
0.60
Opt out of screening
0.40
Infected
0.19
0.114
Uninfected
0.81
Infected
0.09
Uninfected
0.91
Early
0.55
Late
0.45
0.0627
Not treated
0.10
0.90
0.32
0.68
0.076
0.924
0.379
0.621
0.076
0.924
Perinatal death
0.00627
Survival
0.05643
Perinatal death
0.01642
Survival
0.03488
Perinatal death
0.03693
Survival
0.22678
Perinatal death
0.01364
Survival
0.02236
Perinatal death
0.02766
Survival
0.33634


14,523
Pregnant women
1.0
No intervention
0.15
Infected
0.379
Perinatal death
0.621
Survival
0.85
Uninfected
0.076
Perinatal death
0.924
Survival
0.05685
826
Intervention (screening)
Opt in to screening
0.60
Infected
0.19
Early
0.55
0.10
Perinatal death
0.90
Survival
Late
0.45
0.32
Perinatal death
0.68
Survival
Uninfected
0.81
0.076
Perinatal death
0.924
Survival
14,523 * 0.15 * 0.379 = 826
14,523 * 0.05685 = 826
0.40
Opt out of screening
0.09
Infected
Not treated
0.379
Perinatal death
0.621
Survival
0.91
Uninfected
0.076
Perinatal death
0.924
Survival

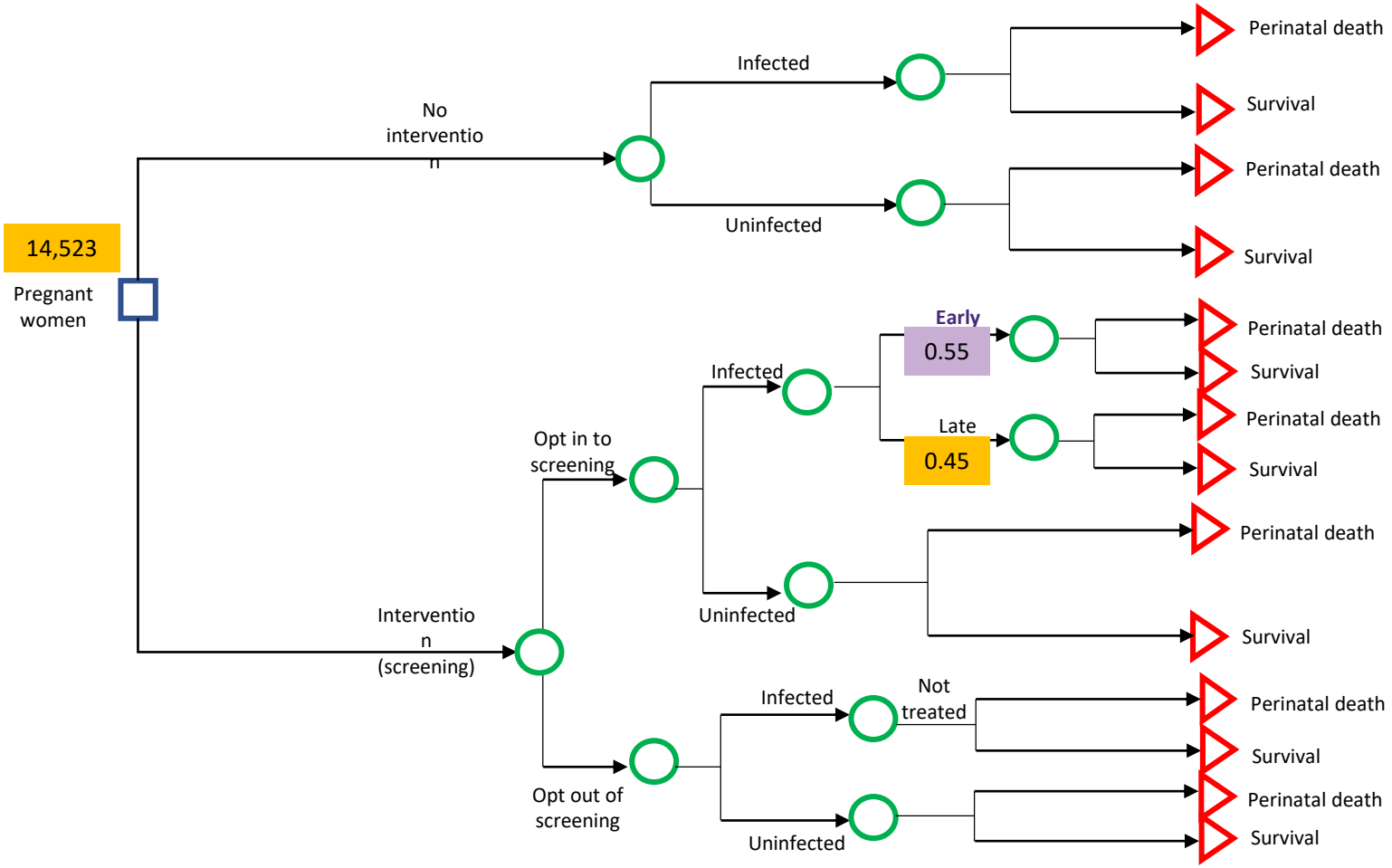

14,523
Pregnant women
No intervention
0.15
Infected
0.379
Perinatal death
826
0.621
Survival
1,353
0.85
Uninfected
0.076
Perinatal death
938
0.924
Survival
11,406
Intervention (screening)
Opt in to screening
0.60
Infected
0.19
Early
0.55
0.10
Perinatal death
91
0.90
Survival
820
Late
0.45
0.32
Perinatal death
238
0.68
Survival
507
Uninfected
0.81
0.076
Perinatal death
536
0.924
Survival
6522
Opt out of screening
0.40
Infected
0.09
Not treated
0.379
Perinatal death
198
0.621
Survival
325
Uninfected
0.91
0.076
Perinatal death
402
0.924
Survival
4,885


14,523
Pregnant women
Numbers of the right should sum to total population (14,523) for each intervention option
826 + 1,353 + 938 + 11,406 = 14,523
No intervention
0.15
Infected
0.379
Perinatal death
826
0.621
Survival
1,353
0.85
Uninfected
0.076
Perinatal death
938
0.924
Survival
11,406
Intervention (screening)
0.60
Opt in to screening
Infected
0.19
Early
0.55
0.10
Perinatal death
91
0.90
Survival
820
Late
0.45
0.32
Perinatal death
238
0.68
Survival
507
0.81
Uninfected
0.076
Perinatal death
536
0.924
Survival
6522
0.40
Opt out of screening
0.09
Infected
Not treated
0.379
Perinatal death
198
0.621
Survival
325
0.91
Uninfected
0.076
Perinatal death
402
0.924
Survival
4,885


14,523
Pregnant women
No intervention
Deaths with Option 1:
826 + 938 = 1,764
Deaths with Option 2:
91+238+536+198+402 = 1,466
0.15
Infected
0.85
Uninfected
0.379
0.621
0.076
0.924
Perinatal death 826
Survival 1,353
Perinatal death 938
Survival 11,406
Intervention (screening)
0.60
Opt in to screening
0.40
Opt out of screening
0.19
Infected
0.81
Uninfected
Early
0.55
Late
0.45
0.10
0.90
0.32
0.68
Perinatal death 91
Survival 820
Perinatal death 238
Survival 507
0.076
0.924
Perinatal death 536
Survival 6522
0.09
Infected
0.91
Uninfected
Not treated
0.379
0.621
0.076
0.924
Perinatal death 198
Survival 325
Perinatal death 402
Survival 4,885

Syphilis screen & treat results

- **Perinatal deaths**
  - No intervention: 1,764
  - Intervention (screen & treat): 1,466
- **Infant deaths prevented with intervention**
  - 1,764 – 1,466 = **298**


14,523
Pregnant women
No intervention
Infected
Perinatal death
Survival
Uninfected
Perinatal death
Survival
Intervention (screening)
Opt in to screening
Infected
Early
0.55
Perinatal death
Survival
Late
0.45
Perinatal death
Survival
Uninfected
Perinatal death
Survival
Opt out of screening
Infected
Not treated
Perinatal death
Survival
Uninfected
Perinatal death
Survival

Review of syphilis program policy options

- **In rural Philippines, syphilis in pregnant women accounts for many adverse pregnancy outcomes**
- **Group of antenatal clinics (ANCs) in a high-burden rural area are trying to decide if they should screen and treat pregnant women for syphilis**
  - **Option 1. Not screen or treat pregnant women (status quo)**
  - **Option 2. To screen and treat and require $3 from patient**
  - **Option 3. Treat without screening & require $3 from patient**
- **Which option to choose?**

Using Excel as a Decision Tree Tool

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Why use Excel for decision trees?

- Easy way to do analyses
- Can perform quick economic evaluations
- Worksheets may be saved, formatted, or printed
- Allows users to perform calculations using their own data
- Can conduct sensitivity analyses easily
- Everyone has a copy
- May not have sophisticated software (TreeAge)

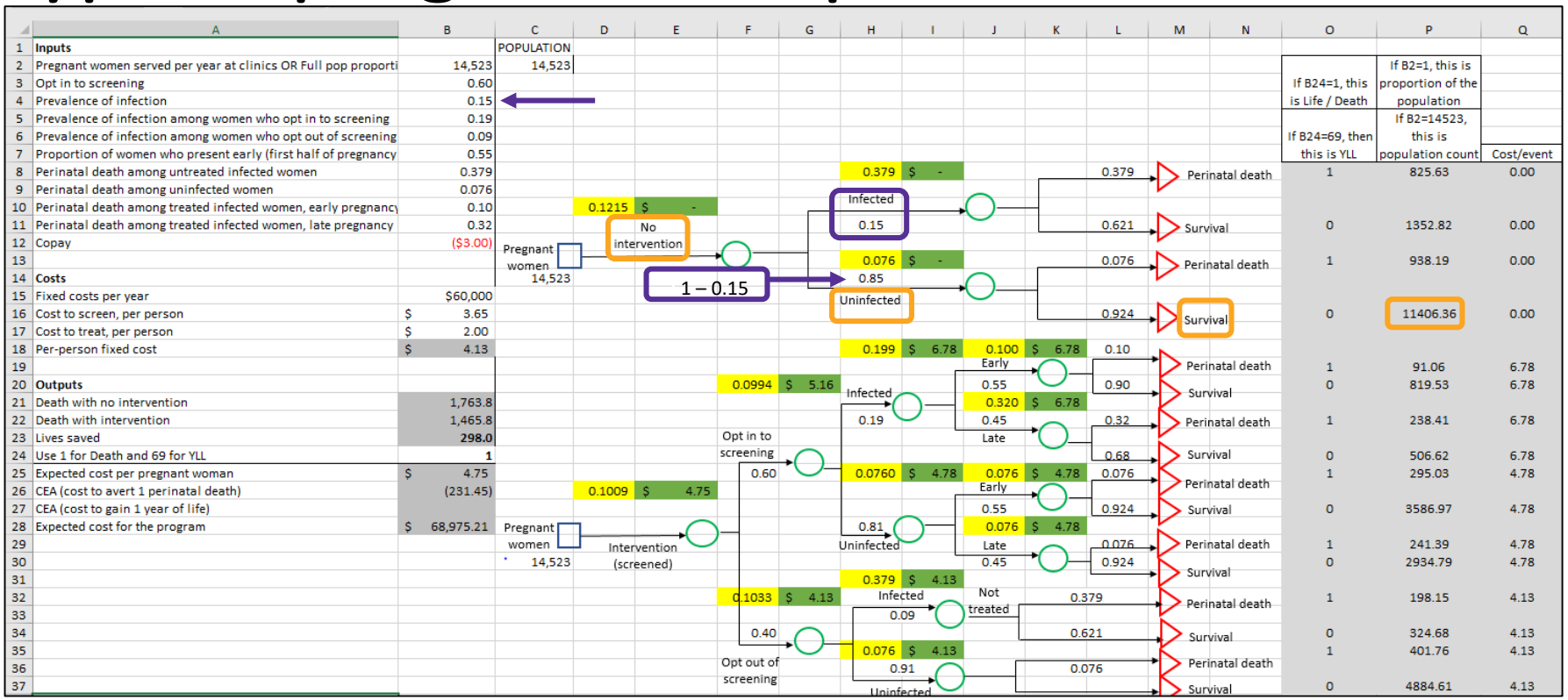
Excel-based model components

- Population
- Probabilities
- Cost of cases & intervention

Inputs		
Pregnant women served per year at clinics OR Full pop proporti		14,523
Opt in to screening		0.60
Prevalence of infection		0.15
Prevalence of infection among women who opt in to screening		0.19
Prevalence of infection among women who opt out of screenin		0.09
Proportion of women who present early (first half of pregnancy		0.55
Perinatal death among untreated infected women		0.379
Perinatal death among uninfected women		0.076
Perinatal death among treated infected women, early pregnanc		0.10
Perinatal death among treated infected women, late pregnancy		0.32
Copay		($3.00)
Costs		
Fixed costs per year		$60,000
Cost to screen, per person	$	3.65
Cost to treat, per person	$	2.00
Per-person fixed cost	$	4.13
Outputs		
Death with no intervention		1,763.8
Death with intervention		1,465.8
Lives saved		**298.0**
Use 1 for Death and 69 for YLL		**1**
Expected cost per pregnant woman	$	4.75
CEA (cost to avert 1 perinatal death)		(231.45)
CEA (cost to gain 1 year of life)		
Expected cost for the program	$	68,975.21

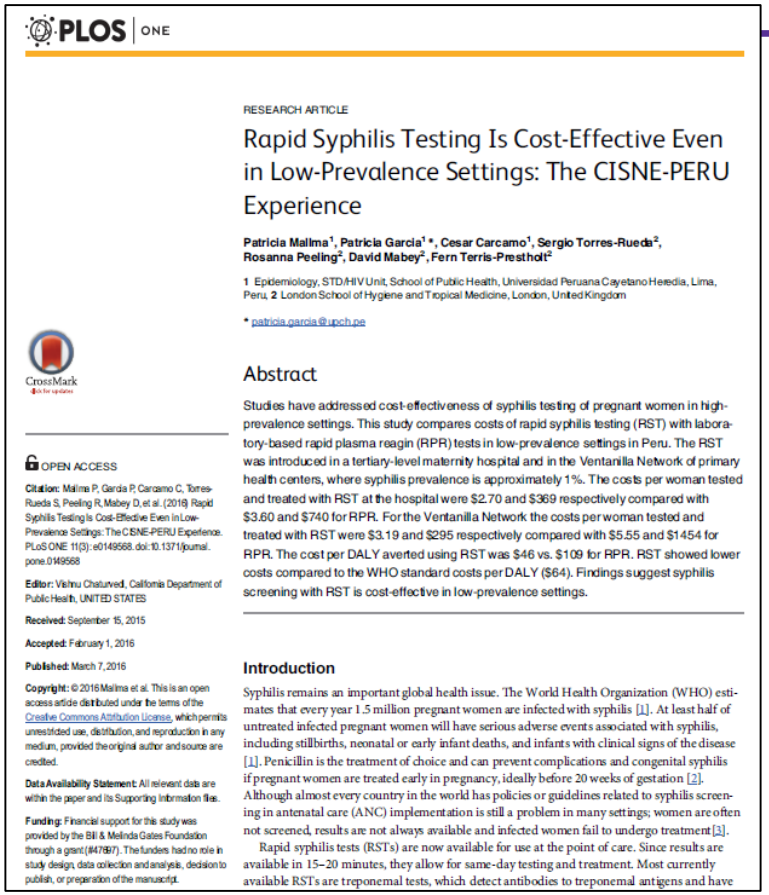
Excel-based syphilis program model

Syphilis program example Excel sheet



Making an Excel sheet for your model

- Review the Excel decision tree models in your flash drive
  - Modify the inputs and see how it affects the model outputs
- Make your first decision tree by hand before transferring it to Excel
- Your mentor can help you!



PLOS | ONE

RESEARCH ARTICLE

Rapid Syphilis Testing Is Cost-Effective Even in Low-Prevalence Settings: The CISNE-PERU Experience

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Abstract

Studies have addressed cost-effectiveness of syphilis testing of pregnant women in high-prevalence settings. This study compares costs of rapid syphilis testing (RST) with laboratory-based rapid plasma reagin (RPR) tests in low-prevalence settings in Peru. The RST was introduced in a tertiary-level maternity hospital and in the Ventanilla Network of primary health centers, where syphilis prevalence is approximately 1%. The costs per woman tested and treated with RST at the hospital were $2.70 and $369 respectively compared with $3.60 and $740 for RPR. For the Ventanilla Network the costs per woman tested and treated with RST were $3.19 and $295 respectively compared with $5.55 and $1454 for RPR. The cost per DALY averted using RST was $46 vs. $109 for RPR. RST showed lower costs compared to the WHO standard costs per DALY ($64). Findings suggest syphilis screening with RST is cost-effective in low-prevalence settings.

OPEN ACCESS

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Introduction

Syphilis remains an important global health issue. The World Health Organization (WHO) estimates that every year 1.5 million pregnant women are infected with syphilis [1]. At least half of untreated infected pregnant women will have serious adverse events associated with syphilis, including stillbirths, neonatal or early infant deaths, and infants with clinical signs of the disease [1]. Penicillin is the treatment of choice and can prevent complications and congenital syphilis if pregnant women are treated early in pregnancy, ideally before 20 weeks of gestation [2]. Although almost every country in the world has policies or guidelines related to syphilis screening in antenatal care (ANC) implementation is still a problem in many settings; women are often not screened, results are not always available and infected women fail to undergo treatment [3].

Rapid syphilis tests (RSTs) are now available for use at the point of care. Since results are available in 15–20 minutes, they allow for same-day testing and treatment. Most currently available RSTs are treponemal tests, which detect antibodies to treponemal antigens and have

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END

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