Economic Analysis for Adding Newborn Screening for Arginase-1 deficiency

Washington State Board of Health

September 8, 2023

Background

- The Board creates a technical advisory committee (TAC), which then reviews available information and research to evaluate a candidate condition and compare to a set of criteria established by the Board

- **Criterion #5:**
  - **Cost-benefit/Cost-effectiveness:** The outcomes outweigh the costs of screening
  - All outcomes, both positive and negative, need to be considered for analysis

Criterion #5

- Important considerations for economic analysis:
  - The prevalence of the condition among newborns
  - The positive and negative predictive values of the screening and diagnostic tests
  - Variability of clinical presentation by those who have the condition
  - The impact of ambiguous results: for example, the impact on families and caregivers
  - Adverse effects of screening

Arginase-1 deficiency (ARG1-D)

- Rare, inherited disorder - part of the urea cycle
- Arginase enzyme is lacking
  - Usually assists with the removal of nitrogen
  - Results in the formation of arginine and ammonia
- Leads to disability
  - Intellectual and developmental delay
  - Spasticity of the lower limbs
  - Seizures
  - Severe hyperammonemia can result in liver transplantation
- Symptoms do not appear until 1-3 years old
- 34 states current screen for ARG1-D in their newborn screening panels
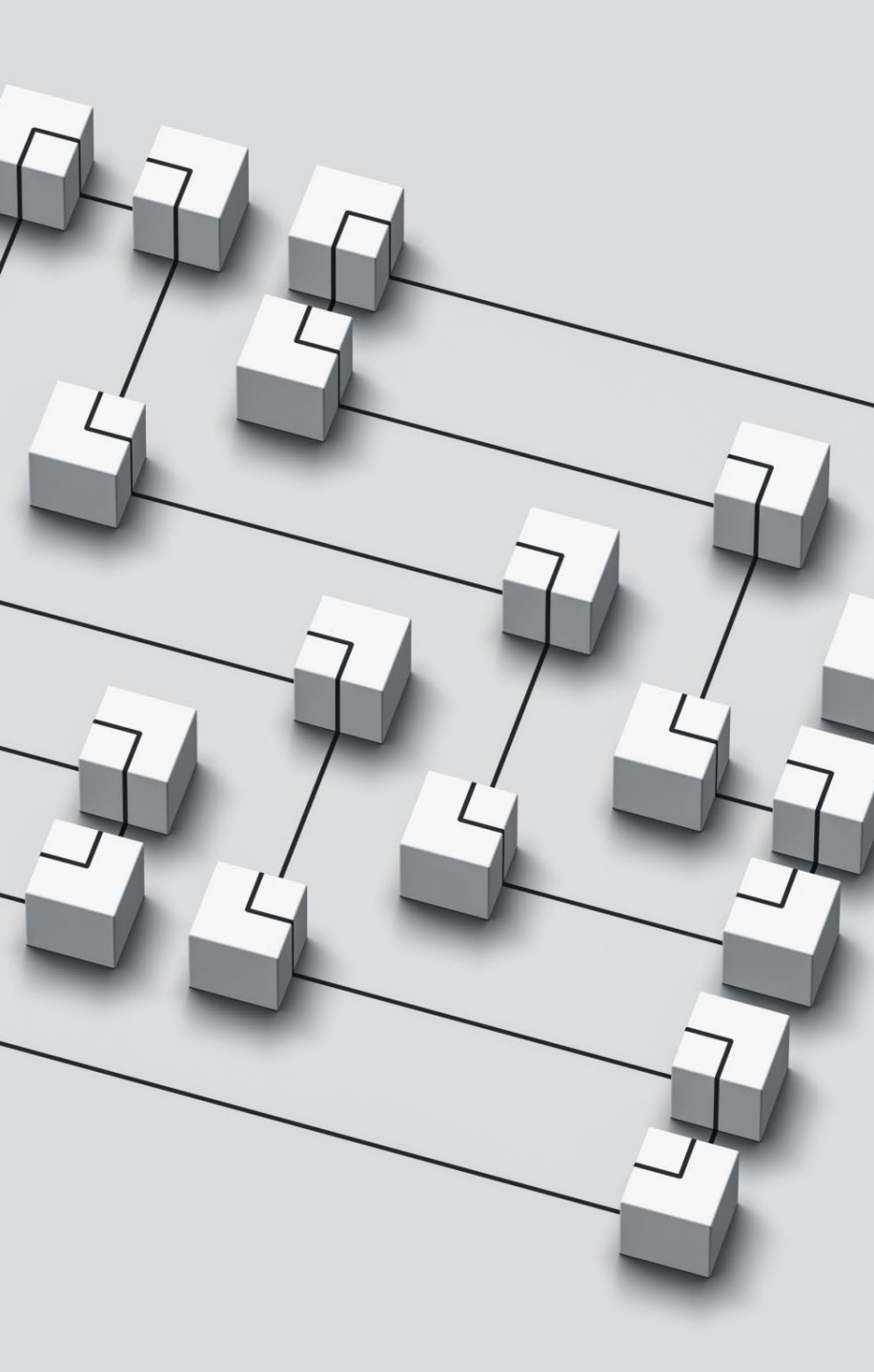
Overview of Benefit-Cost Analysis

■ Decision tree construction: comparison of the current, No Screening Model and a new, Screening Model

■ Data:

  – Existing, published literature

  – States that currently screen for ARG1-D

  – Expert, clinical opinion

■ Sensitivity Analysis: comparing to higher and lower parameters to challenge the model
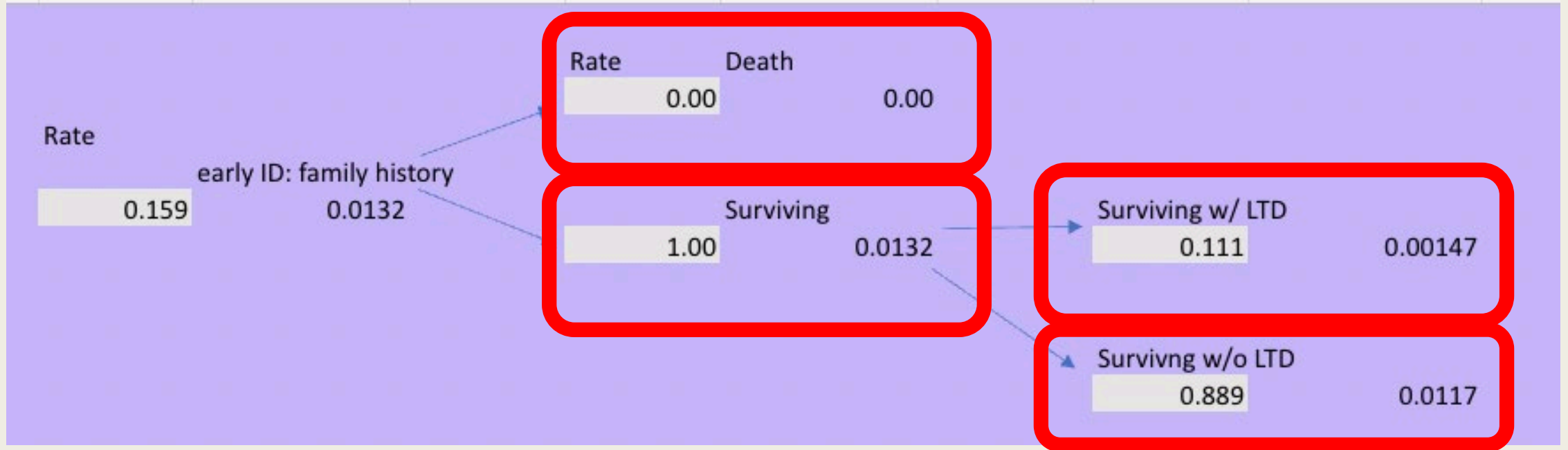
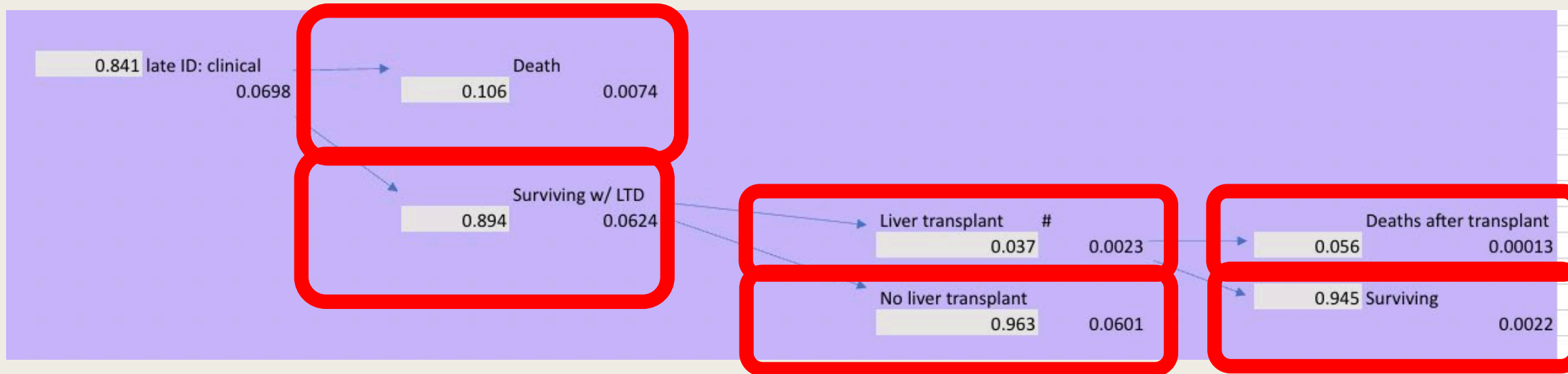# Decision Tree Model
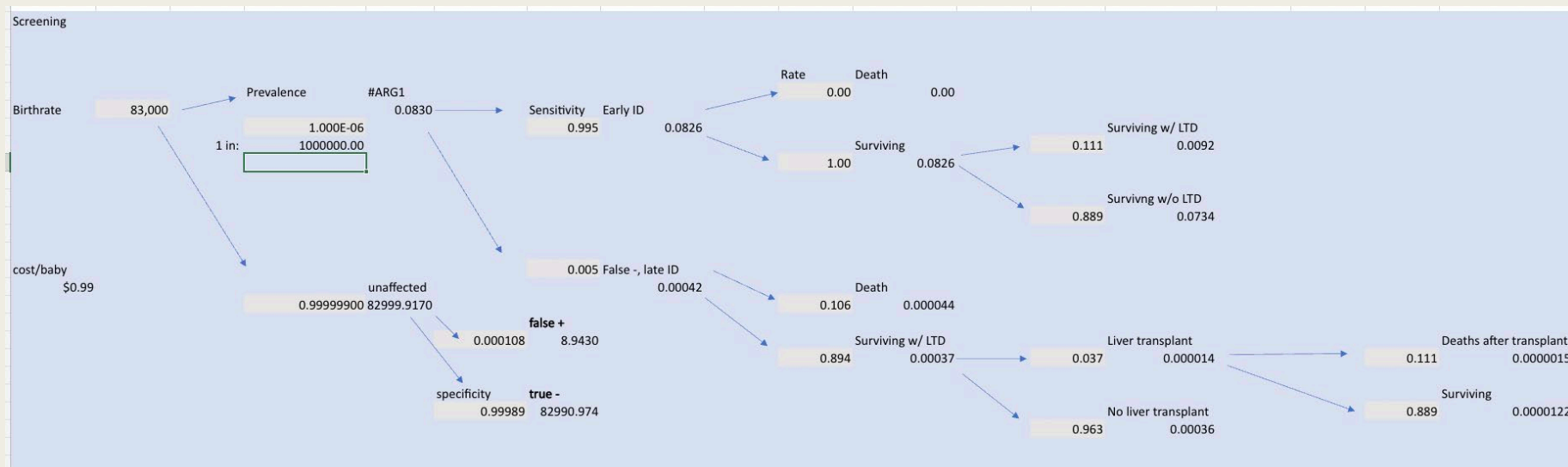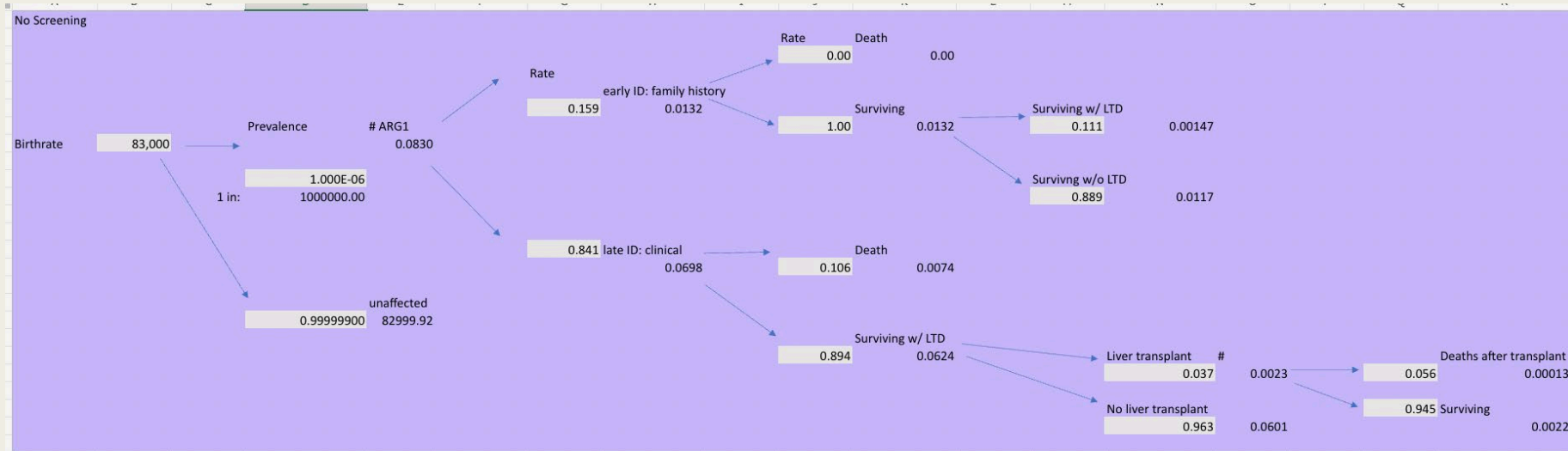
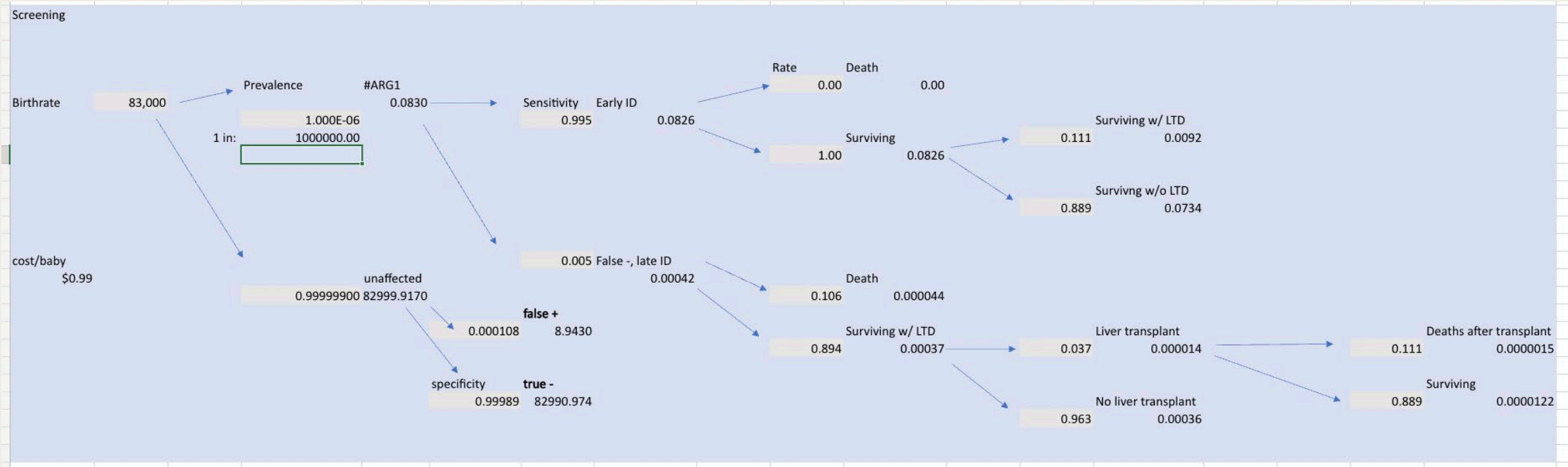# No Screening Model
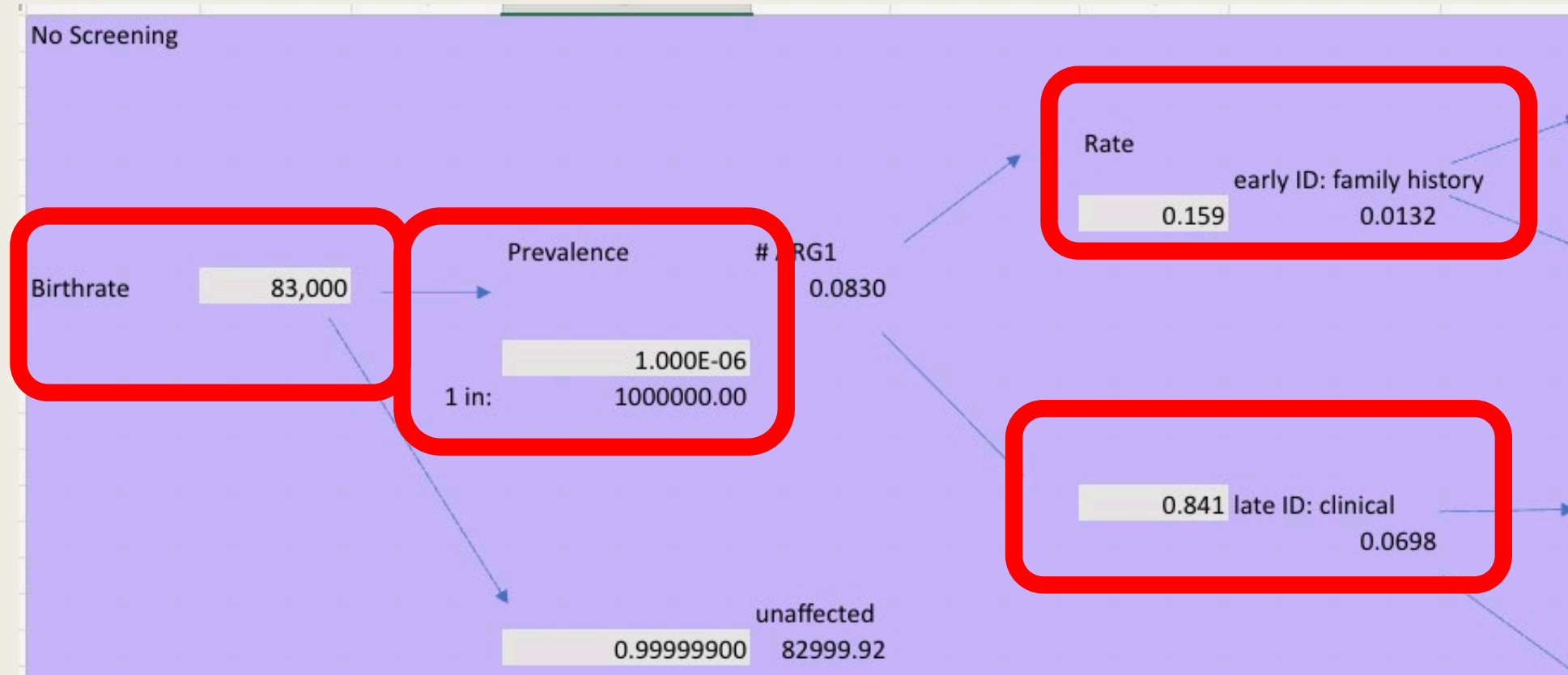
No Screening Model

No Screening Model

Newborn Screening Model

Newborn Screening Model

unaffected
0.99999900 82999.9170

false +
0.000108   8.9430

specificity   true -
0.99989   82990.974

Newborn Screening Model
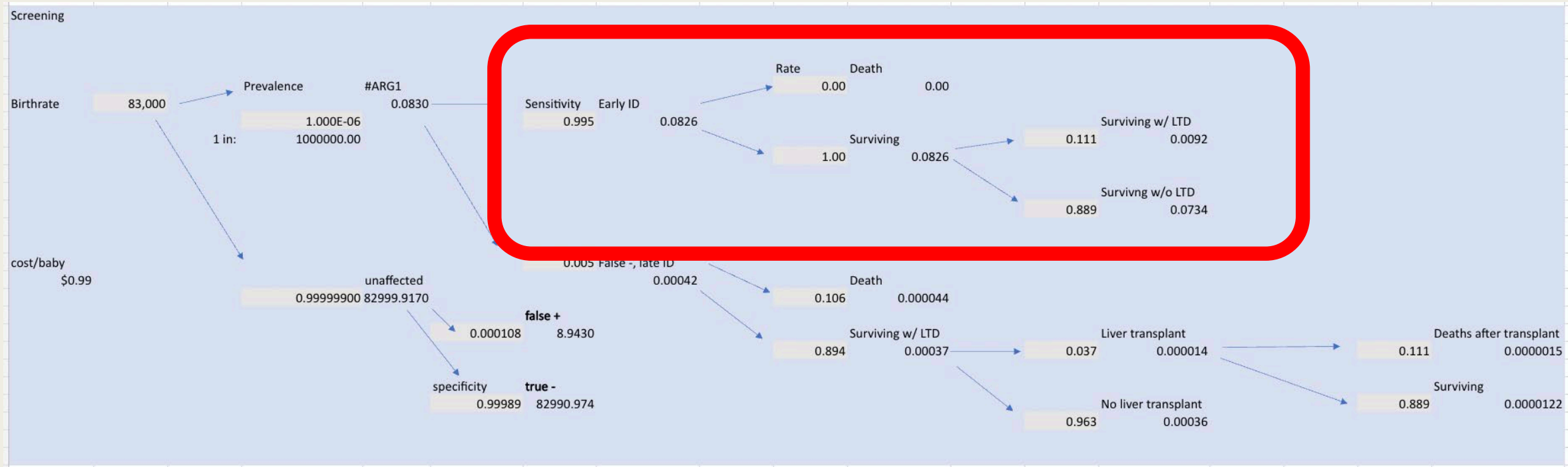
Newborn Screening Model
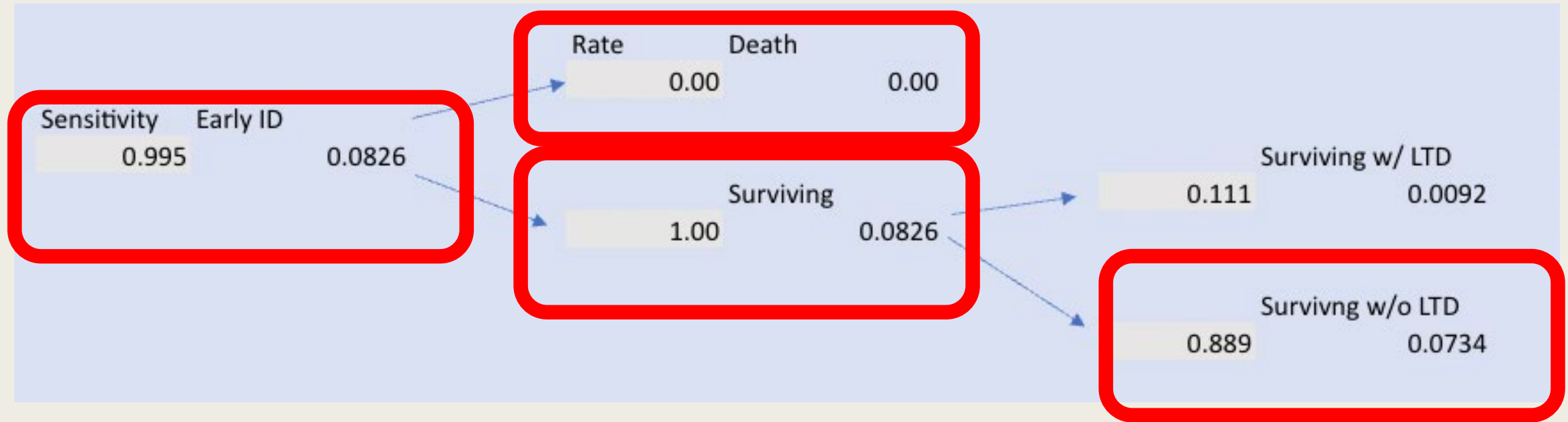
Newborn Screening Model
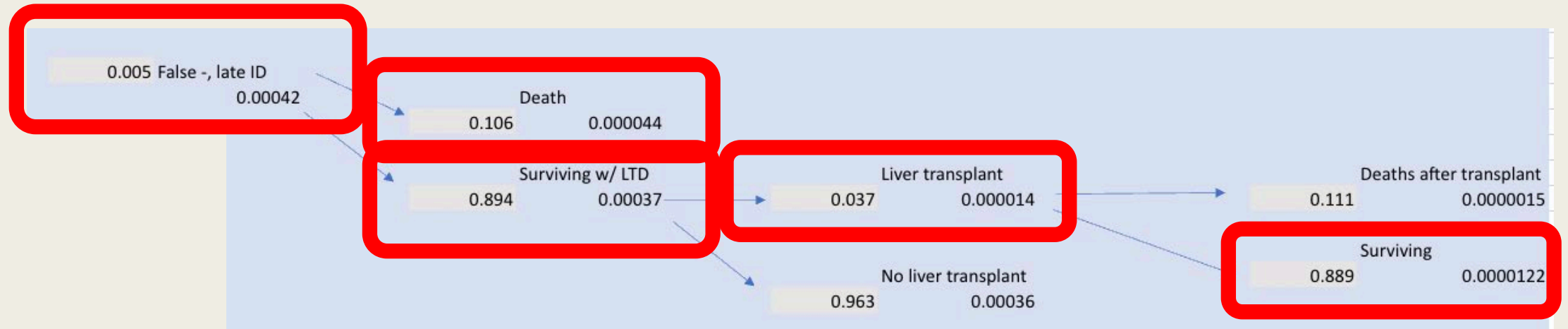
No Screening vs. Screening

No Screening		
	Deaths	0.0075
	Surviving w/LTD	0.0637
	Surviving w/o LTD	0.0117
	Early tx costs	$19,853.16
	Late tx costs	$114,264.14
	Total costs	$134,117.30

Screening		
	Deaths	0.0000456
	Surviving w/LTD	0.0095
	Surviving w/o LTD	0.0734
	Early tx costs	$124,167.36
	Late tx costs	$679.41
	Total costs	$124,846.77

Estimated Treatment Costs

Early tx cost per baby (10 Years)

$1,503,509.80

Late tx cost per baby (10 Years)

$1,637,128.67

Shifts: Benefits vs. Costs

Benefits	Deaths averted	0.00750
	LTD averted	0.0542
	Value of LTD averted	$81,259.71
	Value of a life	$11,600,000.00
	Value of lives saved	$86,981.13
	Less tx costs	$9,270.54
	Total benefits	$177,511.38

Costs

Costs	costs of screening	$82,008.19
	costs of false +	$5,255.13
	Total costs	$87,263.32

Cost per baby: **$0.99**
Includes startup lab costs,
laboratory staffing and
supplies

Costs

Costs	costs of screening	$82,008.19
	costs of false +	$5,255.13
	Total costs	$87,263.32

Plasma test for argenine levels (AA)

	high	low	average	
	$499.00	$202.00	$350.50	
	$200.00	$100.00	$150.00	
			$250.25	Avg cost
DNA seq	$990.00	$710.00	$850.00	
Single gene for ARG1			$1,000.00	
			$925.00	Avg cost
Total diagnostic costs (avg of both tests)			$587.63	

Shift: Benefits vs. Costs

Benefits		
	Deaths averted	0.00750
	LTD averted	0.0542
	Value of LTD averted	$81,259.71
	Value of a life	$11,600,000.00
	Value of lives saved	$86,981.13
	Loss to costs	$9,270.54
	Total benefits	$177,511.38

Costs		
	costs of screening	$82,008.19
	costs of false +	$5,255.13
	Total costs	$87,263.32

benefit/cost ratio	2.03
Net benefit	$90,248.06

Sensitivity Analysis

Parameter	base
Birthrate	83,000
birth prevalence - 1 in:	1000000
% w/ ARG1-D family hx	0.159090909
sensitivity	99.50%
specificity	99.99%
treatment cost, late ID	$1,637,129
value of a life	$11,600,000.00
cost of NBS	$0.99
cost of false +	$587.63

Sensitivity Analysis

Parameter	B/C ratio swing	low/conservative estimate	B/C ratio 2.03 base	high/liberal estimate	B/C ratio swing
birth prevalence - 1 in:	1.87	108800	1000000	54065.67	37.62
sensitivity	1.99	97.50%	99.50%	100%	2.05
specificity	0.99	99.80%	99.99%	100%	2.16
treatment cost, late ID	1.38	$818,564.33	$1,637,129	$3,274,257.33	3.34
value of a life	1.86	$9,600,000.00	$11,600,000.00	$13,600,000.00	2.21
cost of NBS	3.83	$0.50	$0.99	$1.48	1.39
cost of false +	2.1	$293.81	$587.63	$5,876.25	1.32

Sensitivity Analysis

Parameter	B/C ratio swing	low/conservative estimate	B/C ratio 2.03 base	high/liberal estimate	B/C ratio swing
Birthrate	2.03	62250	83,000	103750	2.03
birth prevalence - 1 in:	1.87	108800	1000000	54065.67	37.62
% w/ ARG1-D family hx	2.42	0	0.159090909	0.33	1.62
sensitivity	1.99	97.50%	99.50%	100%	2.05
specificity	0.99	99.80%	99.99%	100%	2.16
treatment cost, late ID	1.38	$818,564.33	$1,637,129	$3,274,257.33	3.34
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Criterion #5

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Final Notes

Current data suggests no false negatives

Treatment costs can vary

Babies asymptomatic until toddlerhood – candidate for newborn screening

Acknowledgements

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- Greg Bonn, MT (ASCP), Colorado State Public Health and Environment Laboratory

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