Using Costs in Cost-Effectiveness Models for Chronic Diseases: Lessons from Diabetes

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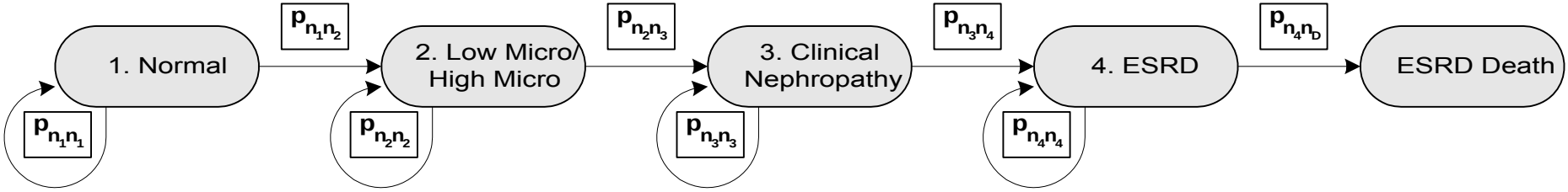
CE Models for Chronic Disease: Key Issues

- Long time horizons
  - Interventions now, benefits later
- Simulate results, because trials infeasible
- Diseases often complex
- Disease progression is key
- Costs? Almost an afterthought
- Our diabetes model illustrates these issues

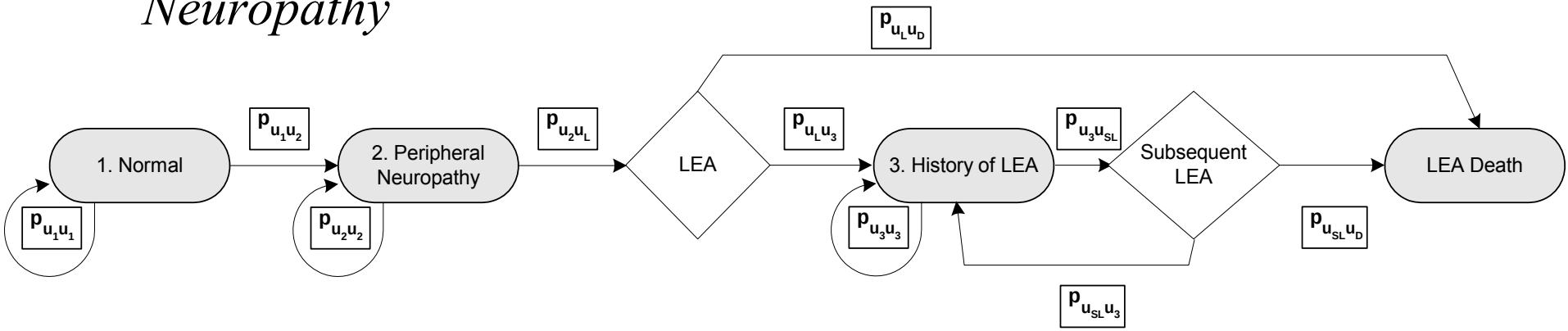
The CDC-RTI Diabetes Cost-Effectiveness Model

- Markov model of disease progression and cost-effectiveness
- Follows patient from diabetes diagnosis to death or age 95
- Follows development of complications on 5 disease paths
  - Nephropathy, neuropathy, retinopathy
  - CHD and stroke
- 20,000+ lines of code in C++
- Usually focus on health care system perspective

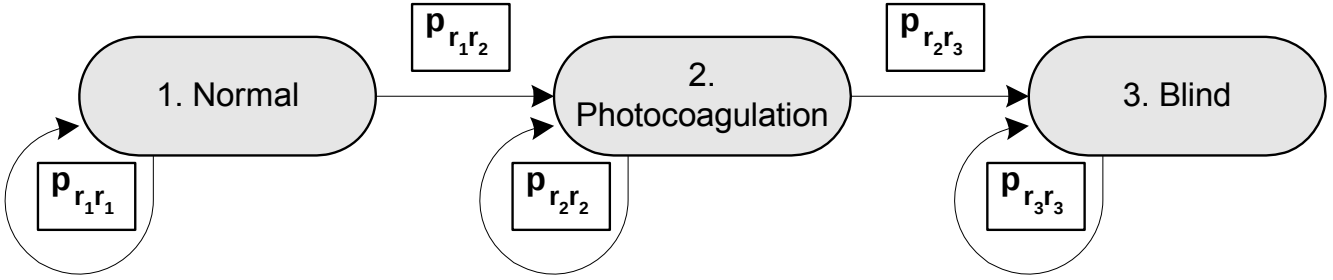
Nephropathy

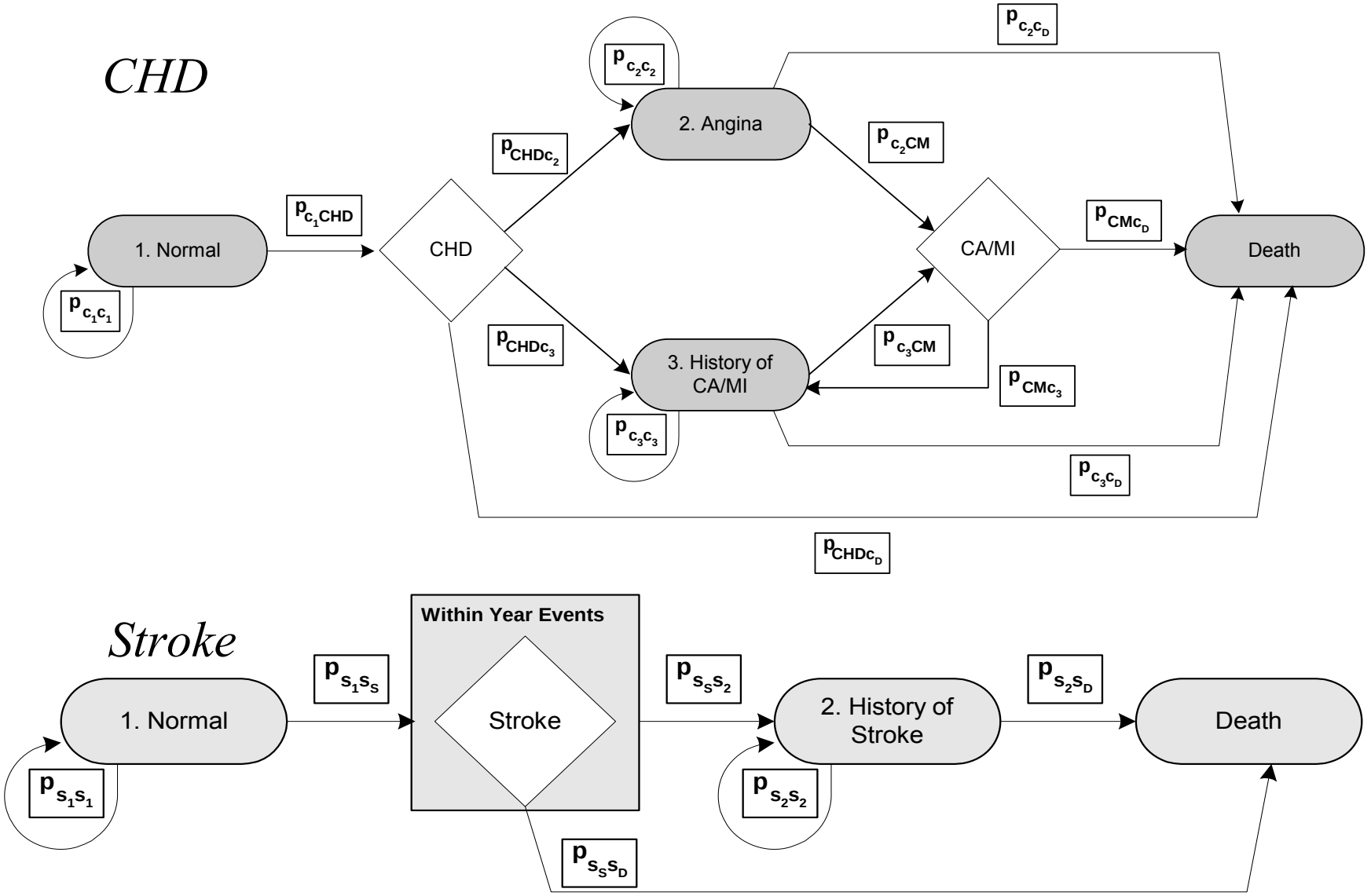


Neuropathy



Retinopathy

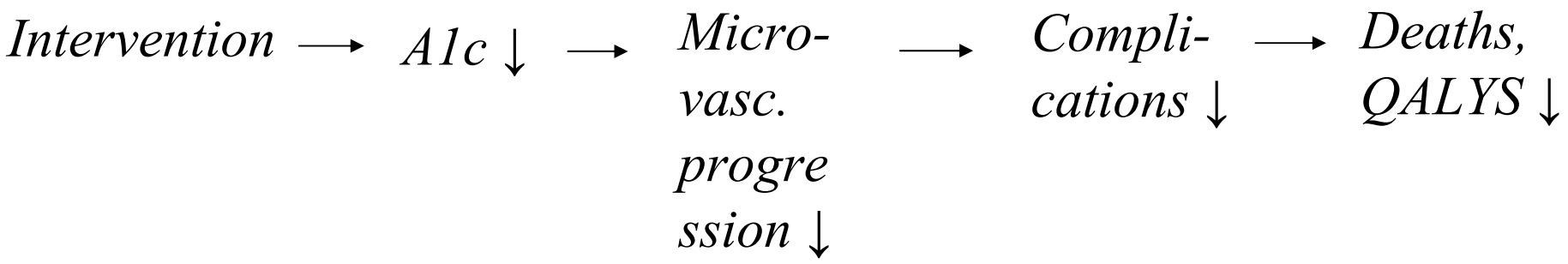




Point: Lots of work on disease progression (50% of project)

Lots of Work on Intervention Effects

- Randomized clinical trials
  - Provide effects on intermediate outcomes
  - Must simulate effects on long-term outcomes based on disease progression model
- Get it right, or no one believes your results (20%)



When It Comes to Costs… "Grab and Go"

- Budget, time is almost gone (need to save time for analysis, reporting)
- Find cost data in the literature
- Don't look too carefully
- Stick it in, and get results

- Far less time (5%), scrutiny than disease progression or intervention effects

How are Costs Measured?

- Direct data collection as part of study
  - Works for intervention costs
  - Micro-costing
  - Usually period is too short for complication costs
    - Too rare, too variable to see significant differences between arms
    - Yet complication costs account for large share of overall diabetes costs

Complication Costs—Option 1

- Cost out individual complication events ("gross" costing)
  - Secondary data
  - Additive form
  - One-time and subsequent annual costs
  - Only need diabetes-related costs
  - Other medical costs drop out of incremental comparison due to additive form

Microvascular Costs (Option 1)

	1-time costs	Annual costs
Microalbuminuria	$0	$0
Nephropathy	$1,201	$0
ESRD	$0	$72,488
Peripheral neuropathy	$357	$0
LEA	$33,131	$0
Photocoagulation	$2,943	$0
Blindness	$0	$2,125

Complication Costs—Option 2

- Cost regressions
  - $\ln Y = \beta X + \varepsilon$
  - x_i are dummy variables for complications
  - Takes on multiplicative form when transformed
  - $Y = k\, e^{\beta X} = k' e^{\beta 1 x 1} e^{\beta 2 x 2} \ldots e^{\beta n x n}$
  - $= k' * mult_1 * mult_2 * \ldots * mult_n$
  - Note: incremental cost of complication depends on all other complications

Multipliers (Option 2)

	Multiplier
Female	1.25
African-Amer.	0.82
Oral agents	1.10
Insulin	1.59
Microalbuminuria	1.17
Nephropathy	1.30
ESRD	10.53

	Multiplier
History of stroke	1.30
Angina	1.73
History of CA/MI	1.90
Periph vasc dis	1.31
Hypertension	1.24
Baseline costs	$1,684

Ex. Female, insulin, microalbuminuria, hypertension

Does It Make a Difference?

	Additive Costs			Multiplicative Costs		
	Total cost	Total QALYs	CE ratio	Total cost	Total QALYs	CE ratio
Baseline	$52,758	12.7547		$55,175	12.7547	
Interven-tion	$54,185	12.8999		$58,418	12.8999	
Incremen-tal	$1,428	0.1452	$9,832	$3,242	0.1452	$22,300

Cost Standards for CEA—the Panel study

	# of rec's
Use societal perspective	1
What should be included in numerator	7
What should be excluded in numerator	3
Micro-costing preferred over gross-costing, but choice depends on feasibility, etc.	1
Value resources at opportunity costs	2
How to use wages and prices to reflect opportunity costs	10
Use constant $	1
Total	25

Gold et al. *Cost-Effectiveness in Health and Medicine.* 1996. Ch.6.

Not in the Panel Recommendations, But Possible Issues for Us to Consider

- Standard cost estimates for CEA (Panel recommended this for future research)
  - Can we come up with a standardized list of complications or conditions that is useful across a wide range of CE analyses?
  - 1-time and annual costs
  - Appropriate data sources
  - Who would do it?

Possible Issues (cont'd)

- Use of regression-based estimates for costs
  - Implications of functional form
- How much emphasis to put on costs in sensitivity analyses
  - Point estimates
  - Underlying variation
- Should we standardize intervention costs?
- Should we standardize non-medical costs?