Economic Evaluation in Child Health: Playing Outside of the Sandbox

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Economic Evaluation in Child Health

- Do we really need it?...Do we not value investment in child health (at any cost)?
- Incidence of disease in children is low compared to adults
- Much heath care is directed at prevention
- Evidence of efficacy of health care interventions hard to obtain
  - Children prevented from participation in research
  - Insufficient disease prevalence to permit RCTs
  - Health improvements may be deferred by decades

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The NEW ENGLAND JOURNAL of MEDICINE
SPECIAL ARTICLE
Economic Evaluation of Neonatal Intensive Care of Very-Low-Birth-Weight Infants
Michael H. Boyle, M.Sc., George W. Torrance, Ph.D., John C. Sinclair, M.D., and Sargent P. Horwood, M.D. N Engl J Med 1983; 308:1330-1337 June 2, 1983
Abstract
We evaluated the economic aspects of neonatal intensive care of very-low-birth-weight infants, using outcomes and costs of care before and after the introduction of a regional neonatal-intensive care program.
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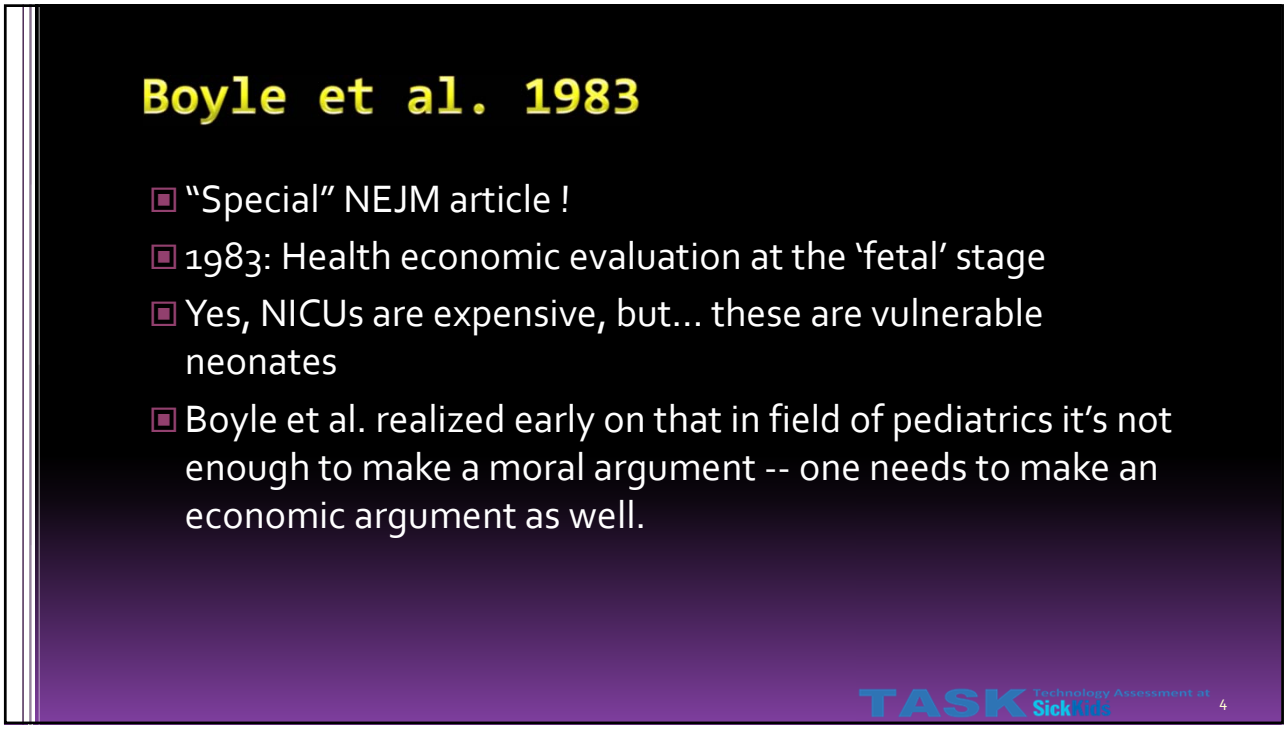
Boyle et al. 1983
"Special" NEJM article !
1983: Health economic evaluation at the 'fetal' stage
Yes, NICUs are expensive, but… these are vulnerable neonates
Boyle et al. realized early on that in field of pediatrics it's not enough to make a moral argument -- one needs to make an economic argument as well.
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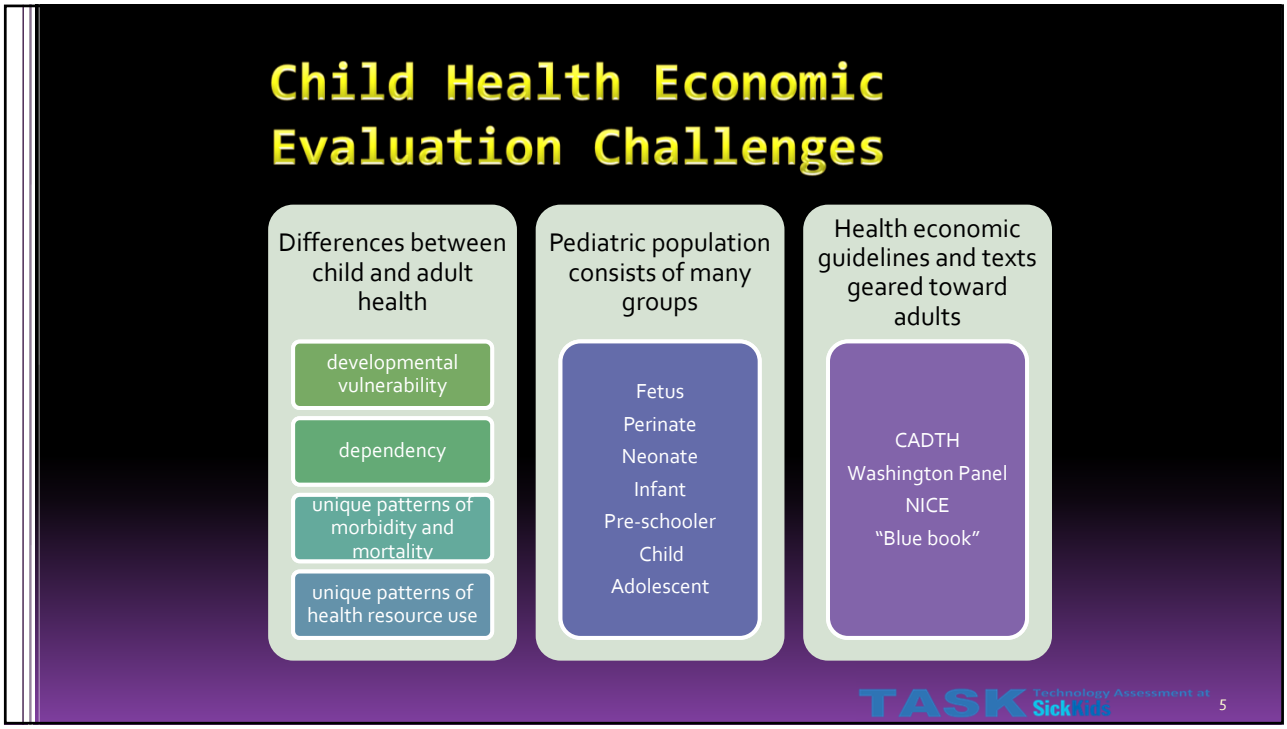
Child Health Economic Evaluation Challenges
Differences between child and adult health
developmental vulnerability
dependency
unique patterns of morbidity and mortality
unique patterns of health resource use
Pediatric population consists of many groups
Fetus
Perinate
Neonate
Infant
Pre-schooler
Child
Adolescent
Health economic guidelines and texts geared toward adults
CADTH
Washington Panel
NICE
"Blue book"
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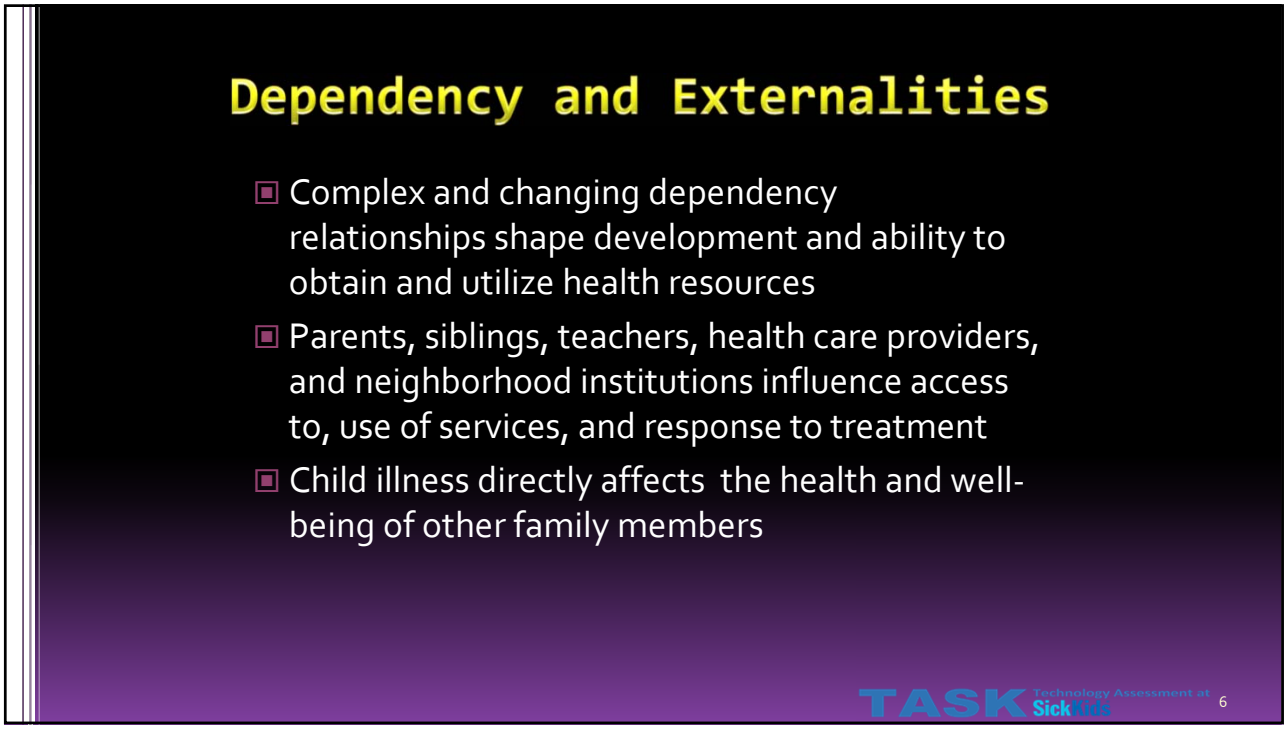
Dependency and Externalities
Complex and changing dependency relationships shape development and ability to obtain and utilize health resources
Parents, siblings, teachers, health care providers, and neighborhood institutions influence access to, use of services, and response to treatment
Child illness directly affects the health and well-being of other family members
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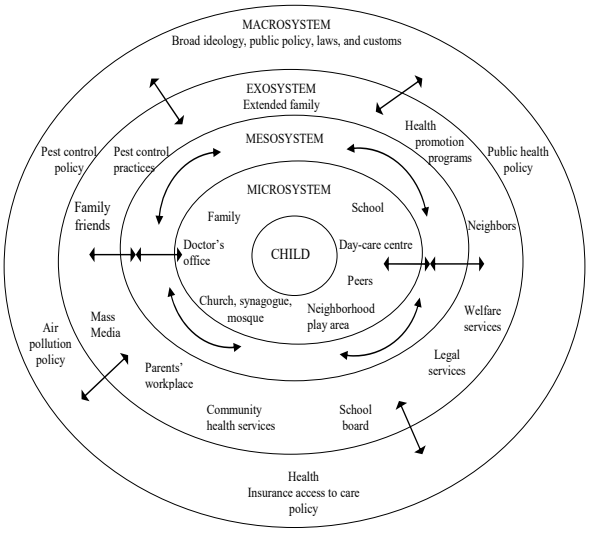
Child Development



Ecological model, Bronfenbrenner 1984:

> *A child's development trajectory is influenced by the interaction of the child, as a biopsychosocial being, with the immediate social milieu and larger social systems.*

Family and peers (micro)

Neighborhood, social environment (exo)

Social policies (macro)

Adapted from Halfon N, Newacheck PW (2000). Characterizing the social impact of asthma in children, in Weiss KB, Buist AS, Sullivan SD (eds) *Asthma's impact on society, the social and economic burden*, Marcel Dekker Inc., New York

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1. Defining and selecting health outcomes
2. Costing
3. Measurement
4. Analysis

Implications for Economic Methods

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Context for Defining and Selecting Health Outcomes

- Interwoven nature of child health with:
  - social determinants of health (income, education, ethnicity)
  - physical environment
  - biologic and genetic determinants
  - behavioural responses
- Natural changes during phases of development

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Measuring Outcomes

Common measures

- Physical symptoms and disease markers
- Functional status, impairment, disability
- Duration of life, mortality
- Quality of life, multiple domains
- Preferences for health states = utility
  → QALYs

Child-focused

- Age group-specific QoL measures
- Days lost from school
- School performance
- Ability to participate in physical activities
- Days lost from recreational activities
- Provider/Caregiver global measures

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Outcome Challenges

- Capturing the full spectrum of social and physiological impacts
  - Detailed family demographics and micro, macro environments
- Defining valid outcome measures for the very young (less than 6 years)
  - Use age-appropriate tools, eg. PedsQL
- Taking developmental change and maturation into account
  - Sample children from each stage
  - Construct models of resource use and outcomes for each stage; assign model inputs to fit each stage

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Resource Consumption

- Multiple settings for care delivery: MD office, clinics, ED, school, daycare, home, community
- Multiple sectors organize, fund and deliver services for children: Health, Education, Community Services, Social Services, Child &Youth Services
- Access to and use influenced by family configuration, geography, SES, language, immigrant status
- Health reform or changes to organization of health services or insurance schemes will have disparate effects on adults and children

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Costing Challenges

- Adequate time horizons
  - Aim for lifelong time horizons, costing by stage of development/age
  - Examine length of interval for which valid data are available
- Uncertainty
  - Consider changes in price inputs over time
  - Conduct probabilistic analysis, extensive sensitivity analysis, sub-analyses, e.g., by age group
- Results may change as a function of perspective
  - Include societal payer perspective
  - Caregiver productivity costs accrue to parents, other family members
  - Absenteeism, presenteeism, change in work status, caregiving activity and consequences

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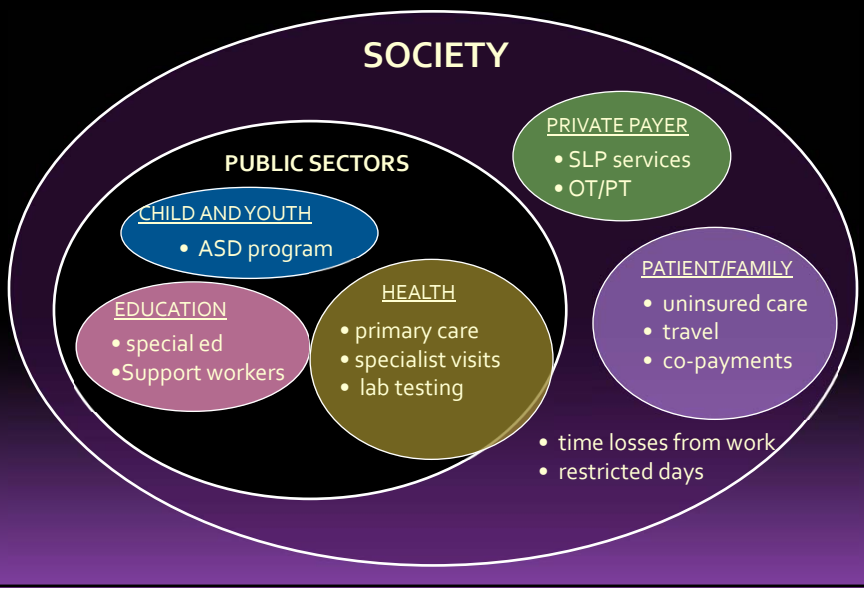
Payer Perspective in Autism Research



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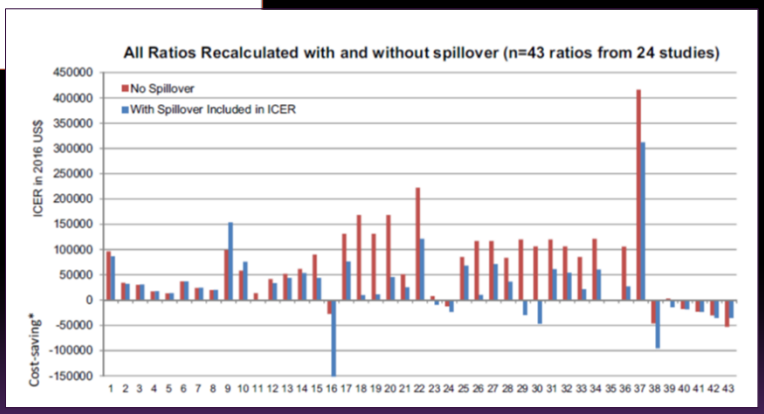
Applied Health Economics and Health Policy (2019) 17:163–174
https://doi.org/10.1007/s40258-018-0436-0

ORIGINAL RESEARCH ARTICLE

Family Spillover Effects in Pediatric Cost-Utility Analyses

Tara A. Lavelle[1] · Brittany N. D'Cruz[1] · Babak Mohit[1] · Wendy J. Ungar[2,3] · Lisa A. Prosser[4] · Kate Tsiplova[2] · Montserrat Vera-Llonch[5] · Pei-Jung Lin[1]

Published online: 22 October 2018



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Washington Panel on Cost-Effectiveness 2016 Update

Impact Inventory

Sector	Type of Impact (list category within each sector with unit of measure if relevant)[a]	Included in This Reference Case Analysis From…Perspective? Health Care Sector	Societal	Notes on Sources of Evidence
Formal Health Care Sector				
Health	Health outcomes (effects)			
	Longevity effects	☐	☐	
	Health-related quality-of-life effects	☐	☐	
	Other health effects (eg, adverse events and secondary transmissions of infections)	☐	☐	
	Medical costs			
	Paid for by third-party payers	☐	☐	
	Paid for by patients out-of-pocket	☐	☐	
	Future related medical costs (payers and patients)	☐	☐	
	Future unrelated medical costs (payers and patients)	☐	☐	
Informal Health Care Sector				
Health	Patient-time costs	NA	☐	
	Unpaid caregiver-time costs	NA	☐	
	Transportation costs	NA	☐	
Non–Health Care Sectors (with examples of possible items)				
Productivity	Labor market earnings lost	NA	☐	
	Cost of unpaid lost productivity due to illness	NA	☐	
	Cost of uncompensated household production[b]	NA	☐	
Consumption	Future consumption unrelated to health	NA	☐	
Social Services	Cost of social services as part of intervention	NA	☐	
Legal or Criminal Justice	Number of crimes related to intervention	NA	☐	
	Cost of crimes related to intervention	NA	☐	
Education	Impact of intervention on educational achievement of population	NA	☐	
Housing	Cost of intervention on home improvements (eg, removing lead paint)	NA	☐	
Environment	Production of toxic waste pollution by intervention	NA	☐	
Other (specify)	Other impacts	NA	☐	

Inclusion of caregiver productivity costs in guidelines creates an opening for a broader consideration of family members' costs and health consequences in economic evaluation.

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Measurement

- Lack of valid and reliable instruments
  - Use instruments validated for use in children
- Assessing utility and quality of life in children
  - Use indirect instruments, e.g. HUI, and/or pediatric instrument: CHU-9D, EQ-5D-Y
- Use parent proxy measures for resource use, costs
- Limit parent proxy for reporting outcomes
- Spillover effects
  - Caregiver time losses, caregiver quality-of-life, health effects

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Analysis

- Creating robust decision models
  - Include health states that reflect changes over stages of growth and development
- Costs incurred to multiple individuals
  - Assign child and caregiver costs to family
  - Consider family or household unit of analysis
- Choosing a time horizon
  - Response rates and service use may change as a function of age
  - Different measures used for children and adults
- Effect of discounting
  - Assess consequences of discounting deferred outcomes when up front costs are high
  - Experiment with non-constant or differential discount rates
- Balance uncertainty against validity of available data

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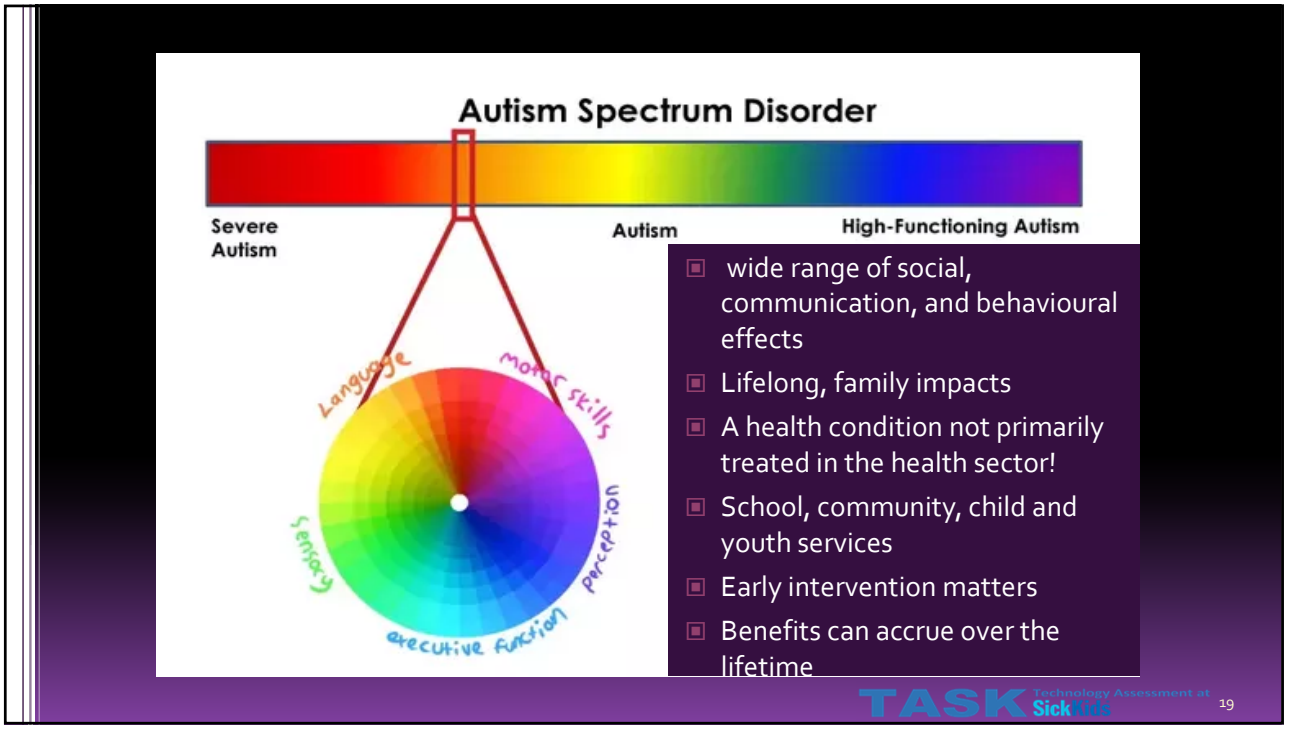
Autism Spectrum Disorder
Severe Autism
Autism
High-Functioning Autism
Language
motor skills
perception
executive function
sensory
wide range of social, communication, and behavioural effects
Lifelong, family impacts
A health condition not primarily treated in the health sector!
School, community, child and youth services
Early intervention matters
Benefits can accrue over the lifetime
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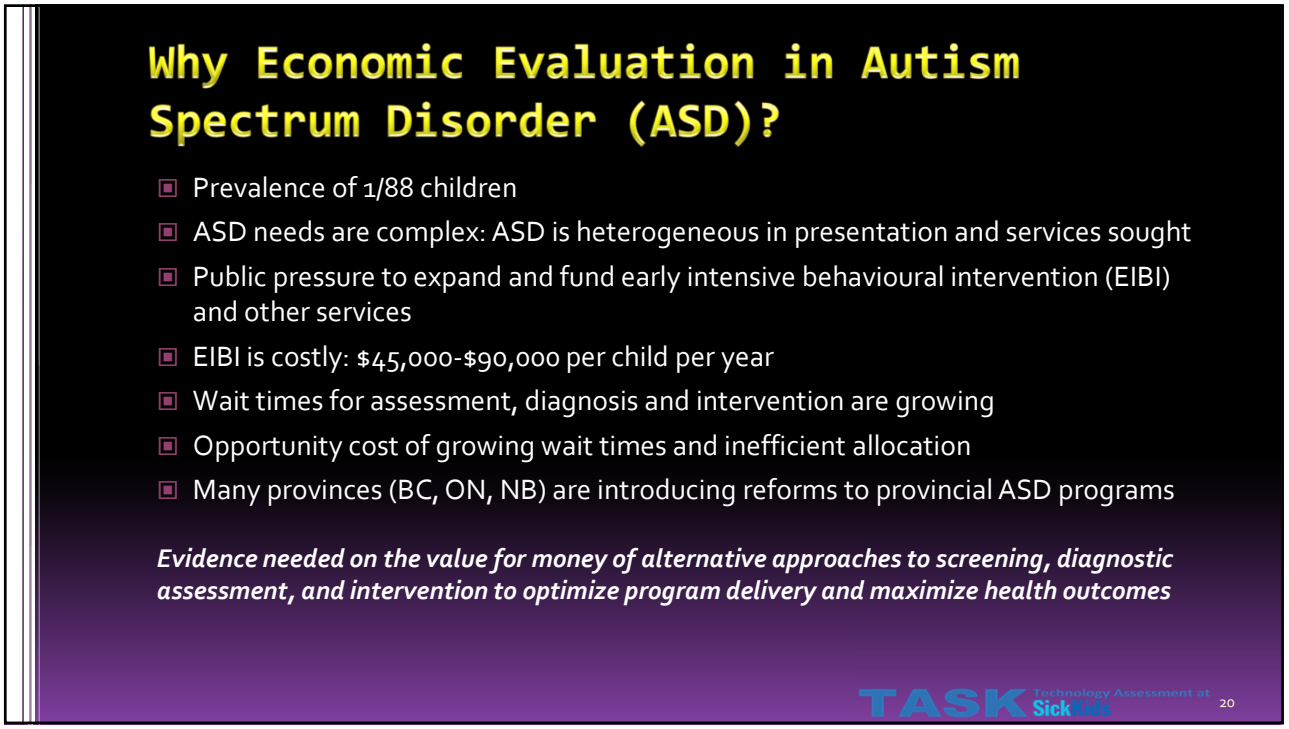
Why Economic Evaluation in Autism Spectrum Disorder (ASD)?
Prevalence of 1/88 children
ASD needs are complex: ASD is heterogeneous in presentation and services sought
Public pressure to expand and fund early intensive behavioural intervention (EIBI) and other services
EIBI is costly: $45,000-$90,000 per child per year
Wait times for assessment, diagnosis and intervention are growing
Opportunity cost of growing wait times and inefficient allocation
Many provinces (BC, ON, NB) are introducing reforms to provincial ASD programs
Evidence needed on the value for money of alternative approaches to screening, diagnostic assessment, and intervention to optimize program delivery and maximize health outcomes
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An additional $1 million has been made available for ASD services. *As an autism program decision-maker, which would you recommend?*

Intervention / Service / Technology	Cost to province per child	Can afford
Special educational supports	$25,000	40
Genome-wide sequencing to aid diagnosis	$2,500	400
Parent-mediated early behavioural intervention	$45,000	22
Respite services for parents	$1,000	1,000

Who's the payer? Whose costs and health consequences matter?

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PACE PARENT & CHILD EARLY COACHING PROJECT

- RCT to assess the costs and effectiveness of a parent-mediated naturalistic developmental behavioral intervention (NDBI) based on ABA and developmental psychology
- Focus on skill learning within a child's daily routines in natural environments (e.g., home, daycare)
- Parents coached by professionals to use strategies that support social-communication development during play and other routines
- Research is emerging in support of parent-delivered NDBI for infants and toddlers with suspected but not yet diagnosed ASD
- Promising approach, especially in jurisdictions with long wait times for ASD diagnostic assessment and treatment initiation

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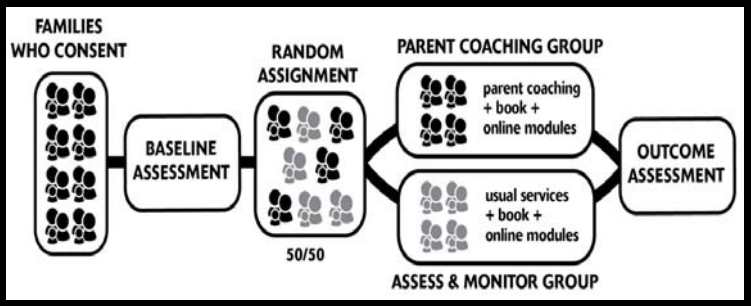
PACE RCT



- Training of parents as coaches and ongoing coaching support (intervention) costs measured pre-RCT and over 24 weeks
- Effectiveness outcomes, resource use and costs measured at baseline and 24 weeks
- Costs quantified over 24 weeks from public payer and societal persepctives

Effectiveness measures:

- MacArthur Bates Communicative Development Inventory:
  - Understand and/or produce words and early and later communicative gestures
- Communication Play Protocol
- Joint Engagement Rating Inventory

Resource use and costs:

- Resource use questionnaire for Toddlers (RUQ-T):
  - Resource use and out-of-pockets costs for a wide range of services across setting and sectors
  - Two parent/caregiver productivity losses

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PACE Study: Cost per child from public payer perspective

Services	TAU (n = 22)					Parent Coaching (n=18)				
	M	SD	Med	Min	Max	M	SD	Med	Min	Max
Speech language pathologist	$313	$324	$166	$0	$922	$0	$0	$0	$0	$0
Applied behaviour analysis	$218	$658	$0	$0	$2,967	$73	$311	$0	$0	$1,318
Infant development worker	$41	$111	$0	$0	$367	$0	$0	$0	$0	$0
Occupational/Physiotherapist	$219	$297	$70	$0	$1,178	$79	$130	$0	$0	$482
Special recreational	$43	$169	$0	$0	$792	$19	$57	$0	$0	$235
Respite	$56	$203	$0	$0	$918	$24	$101	$0	$0	$427
Other services (MCFD)	$35	$96	$0	$0	$430	$4	$18	$0	$0	$75
Total costs of MCFD services	$923	$760	$660	$80	$2,967	$199	$358	$78	$0	$1,338
MoH services	$282	$327	$161	$56	$1,481	$314	$417	$138	$0	$1,495
Total public sector costs, MCFD & MoH	***$1,206***	***$851***	***$859***	***$242***	***$3,051***	***$513***	***$667***	***$260***	***$22***	***$2,833***

Services funded by BC MoH: audiologist, psychologist, optometrist, dentist, dietitian, genetic counsellor, pediatrician, neurologist, gastroenterologist, geneticist, general practitioner, cardiologist, ophthalmologist, otolaryngologist, psychiatrist, registered nurse, nurse practitioner, genetic and other laboratory or imaging tests.

Other services funded by the BC MCFD: social worker, child worker and early childhood educator

Tsiplova et al. *Research in Autism Spectrum Disorders*, 2022

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Next Generation Sequencing

Genome wide sequencing

- **Earlier diagnosis → earlier treatment**
- **Primary target population is children**

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Findings from Sequencing

- *Primary (diagnostic):*
  - targeted search for variants known to be definitely or likely causally related (pathogenic) to reason for testing
  - Target list and length of list varies by indication
- *Secondary (screening):*
  - American College of Medical Genetics and Genomics (ACMG) list of 72 medically actionable variants (e.g. *BRCA1,2*, Lynch syndrome, cardiomyopathies)
  - Penetrance in diverse populations not well established
- Sequencing is performed in **trios!**

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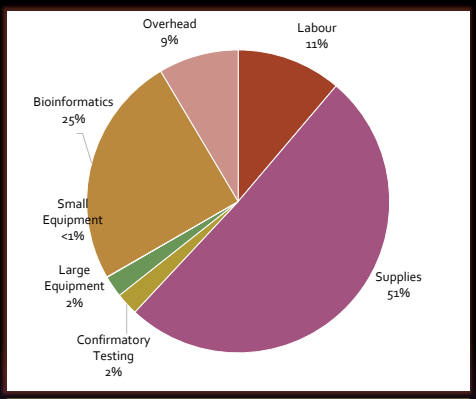
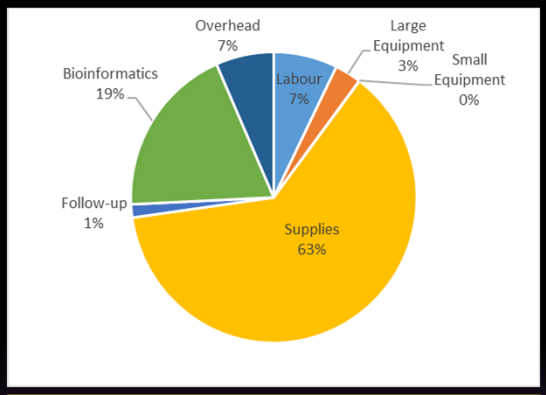
Trio Sequencing Cost per Sample



Cardiac: WGS HiSeqX
CAD $8,053 / US $6,040
(CAD 7699, 8558 / US 5774, 6419)



ASD: WGS HiSeqX
CAD $6,556 / US $4,917
(CAD 6278, 6832 / US 4709, 5124)

From: Jegathisawaran J, Tsiplova K, Hayeems R, Ungar WJ et al. . *Genetics in Medicine, 2022, https://doi.org/10.1016/j.gim.2022.01.020*

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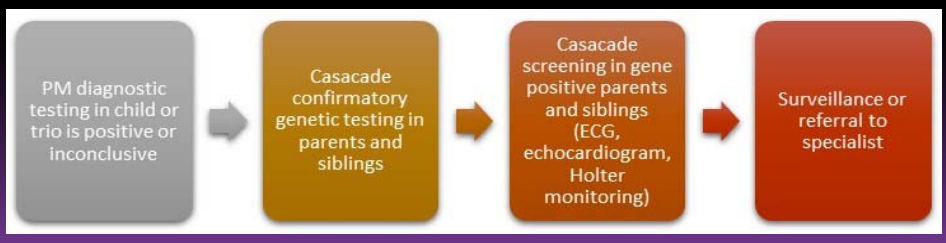
Scope of Economic Analysis

- Should reflect recommended clinical practice: singleton vs. trio
- Primary and secondary variants can trigger cascade testing and increase referrals to specialists for patients and family members
- Trio sequencing can lead to increased surveillance and the possibility of averting adverse long-term outcomes and improving life expectancy for patient and family members

Pediatric cardiomyopathy: Identify genetic variants early to better guide treatment, e.g. implantation of cardioverter defibrillator, to avert sudden cardiac death



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Guidance on Scope

- Canadian, US and UK guidelines for economic evaluation tend to focus on health benefits of individual patients and not affected family members
- While guidelines acknowledge caregiver productivity costs and (in the UK) caregiver health effects, no methodologic guidance for inclusion is provided
- Approaches for integrating costs and QALYs of family members remain experimental
- Family perspective may require alternative unit of analysis:
  - Adjusted child utility or QALYs
  - Child-caregiver pair or dyad
  - Family/Household

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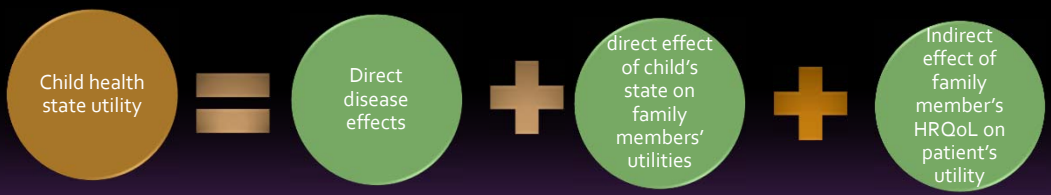
Family Perspective in Measuring Health Benefits in Economic Evaluation

- Interdependency of HRQoL within a family
- Current emphasis on individual preferences for health state valuation assumes the respondent is autonomous
- Value of reporting HRQoL effects on caregivers and other family members



Adapted from Basu A & Meltzer D. *J Health Econ*. 2005; 24:751-773

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Family Perspective

Lamsal 2022: Systematic review of methods used in child health CUA to include family ***health*** spillover effects

Pediatric CUAs (n=29)

- 19 (65%) included estimation in reference case + 10 (35%) in scenario or sensitivity analysis
- 20 (70%) isolated disutility or QALY loss of caregiving vs. 9 (30%) that measured overall utility of caregiver
- 48% used decision analysis + 48% statistical regression
- ~ 8 distinct approaches to determining and aggregating caregiver health effects

Maternal-perinatal CUAs (n=45)

- 35 (78%) measured QALYs and 10 (22%) measured DALYs
- 42 (93%) used decision analysis + 2 (5%) used statistical regression
- ~ 12 distinct approaches to determining and aggregating mother, newborn or joint dyad health effects

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Approaches to Integrating HRQoL of Family Members

Child's health state utility/QALYs adjusted, e.g., reduced, by disutility/QALY loss of caregiving (NICE HST8, 2018)

Child's health state utility reduced by disutility of caregiving in a single model, with model including both child and caregiver health states (NICE HST2, 2015)

QALYs calculated and reported separately for children and caregivers (Chatterton 2019)

QALYs calculated separately for children and family members. Family QALYs added to child QALYs via multiplier (El Janabi 2016) or household welfare function (Tubeuf 2019)

Family perspective via discrete choice experiments with attributes reflecting family effects

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Next Steps and Ongoing Research

- Validation studies ongoing for pediatric-specific preference-based measures of HRQoL (TASK, EQ-5D-Y)
- Comparative performance research (TASK, QUOKKA, TORCH)
- Build consensus on approaches for incorporating family members costs and consequences in economic evaluation (SHEER)
- Discrete choice methods to derive utilities for pediatric health states and benefits to family (Ratcliffe)
- HTA agencies must be part of consensus building to reflect methodologic challenges and advancements
  - ISPOR-NICE Roundtable 2021
  - EuroQol Workshop 2021
  - ISOQOL Measuring What Matters symposium 2022

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Conclusions

- *Child health economic evaluation must:*
  - Respond to needs of:
    - Children and families
    - health care providers making decisions for patients and families
    - Government decision-makers allocating budgets and making policy
  - Consider gaps in methods:
    - Availability and validity of outcome measures
    - Ability to model costs and outcomes over the lifetime
    - Measurement of multi-sectoral and family member costs and consequences
- Be comprehensive and transparent with regard to multi-sectoral effects and impacts for individual payers, including the family
- Economic evaluation guidelines must expand and evolve to consider how pediatric health interventions are delivered and valued

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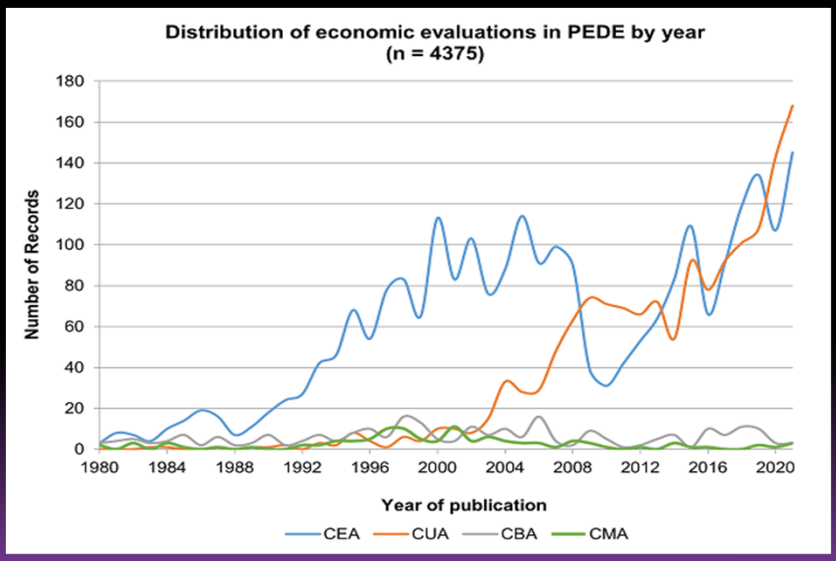
Pediatric Economic Evaluation 1980-2021



From PEDE : pede.ccb.sickkids.ca/pede/index.jsp

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- Corinne Holubowich
- Elaine S. Goh
- Kym M. Boycott
- Nancy Sikich
- Irfan Dhalla
- Vivian Ng

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To learn more …

http://lab.research.sickkids.ca/TASK/

Health Quality Ontario
Let's make our health system healthier

KWDC KTRqwdubr1fd1

https://www.hqontario.ca/Evidence-to-Improve-Care/Health-Technology-Assessment/Ontario-Genetics-Advisory-Committee

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