A cost-benefit analysis of clinical gait analysis for cerebral palsy children

Keshwa Nand Reddy¹, Dr Robyn Grote² and Assoc Prof Luke Connelly³

¹ Ministry of Finance, Fiji
² Queensland Children’s Gait Laboratory, RCH.
³ CONROD, The University of Queensland
Background

- Clinical Gait Analysis (CGA) now accepted in many countries as gold-standard measure of gait, for clinical decision making prior to intervention planning e.g. surgery, pharmaceuticals & orthotics
- CGA for clients with complex problems e.g. neurological, orthopaedic, endocrine, affecting their walking- quantifies & interprets their gait
CGA: 3-dimensional
Background contd

- CGA can monitor interventions & contribute to Evidence Based Practice
- Substantial literature on efficacy & effectiveness of CGA to appraise different procedures e.g. SDR, rectus femoris transfer, tendo achillis lengthening
Background contd

- Fabry: 3-dimensional gait analysis (3DGA) → recommendations for SEML’s

- De Luca: 3DGA → clinicians changed their initial opinion in 52% cases → ↓ procedures → ↓ cost from surgery. Cost benefit of 3DGA implied but not detailed.

- Kay: 3DGA → changed 89% previously recommended surgical procedures
Background contd

• Medline searches since 1996:
  – “gait analysis”- 758 papers
  – “gait analysis laboratory” 145 papers
  – “gait analysis & cost utility/cost effective analysis” 0 papers
  – “gait analysis & cost benefit” 1 paper = Cooper et al (1999) mention “the highest priority … is to research the efficacy, outcomes & cost-effectiveness of gait analysis.”
Background contd

• i.e. Paucity of literature addressing outcome studies of CGA’s!
• CGA is not presently eligible for funding under the Medicare Benefits Scheme
Objectives

• Undertake the 1\textsuperscript{st} (internationally) cost-benefit study of CGA’s –i.e. an economic evaluation of social benefits & social costs of CGA

• Undertake a preliminary study to provide an initial assessment of the necessary scope for a future larger study

• Long-term goal: achieve cost recovery & enhance QCGL efficiency
Design

- **Cost-benefit analysis (CBA)** estimates net benefit of a programme - total benefits less total costs

- **CBA** uses the theory of welfare economics - resource allocation decided on basis of utility levels attained by individuals (social welfare)

- **CBA** promotes economic efficiency – important when resources are scarce & assesses quantifiable avoided costs & indirect benefits on outcomes
Method

1. Data collected from defined set of direct & indirect costs
2. Children (15) assessed at the QCGL were recruited
3. Children’s parents were surveyed
4. Referring clinicians (6) were surveyed pre- & post- the child’s 3DGA.
Method contd

• **Ethics:** clearance from RCH & HSD, UQ.
• **Inclusion/Exclusion criteria:** usual 3DGA criteria
• **Subjects:** 15 children (6-11 years) with cerebral palsy referred for 3DGA to assist intervention planning
• All assessed at same time of day by same assessors- minimising order affects
Method: Parent questionnaire

- Demographics
- Disability history
- Initial & current symptoms
- Treatment to date
- Time spent & costs incurred immediately after 3DGA
- Time spent & costs incurred after 1st return visit to QCGL
- Employment status
- Weekly income
- Time lost from paid & unpaid (e.g. home duties) employment
Method: Referrer questionnaire

- 6 referrers asked for diagnoses, tests ordered, drugs prescribed & proposed treatment/intervention prior to 3DGA
- Repeated after 3DGA
Method contd

• **Total 3DGA time:** extracted from QCGL records- including test, analysis & reporting by multidisciplinary team of Physiotherapists, Medical Engineer, Orthopaedic Specialist, Paediatrician/Rehabilitation Consultant.
Method: costs

- Costs (fixed & variable) & consequences of 3DGA estimated wrt direct clinical costs for pre & post recommended interventions
  - Staffing
  - Use of lab (labour, consumables, utilities, maintenance, cleaning, laundry, rental) & hospital facilities
  - Equipment, administration & accommodation
Analysis

- Compared pre- & post- 3DGA clinical decisions
- Costs & consequences of 3DGA estimated
- Cost-benefit analysis examines marginal cost (costs incurred in producing one additional unit of a good) & marginal benefits (the additional satisfaction/benefit that a consumer derives from an additional unit of a good) of CGA
- Drummond checklist of economic evaluation used = basic criteria set for CBA.
Drummond *(et al 2003)* checklist

1. **Question & perspective-**
   Which method of treating CP (CGA /observation) maximises the difference between the social benefits & costs? Partial perspective due to time limitations- not all societal costs/benefits extrapolated.

2. **Description of alternatives-**
   Compared clinical exam & X-rays Vs 3DGA.
Drummond checklist contd

3. Establishing the effectiveness of the program—considerable literature on usefulness 3DGA & its ability to change treatment options; actual benefits from these changes not well documented—however, increasing use provides indication of perceived effectiveness.
Drummond checklist contd

4. **Identification of costs & consequences** -
   - Costs used by patient & their families
     - In-hospital health sector costs
     - Out-of hospital health sector costs
   - Measures of improvements in treatment & related costs & benefits
Drummond checklist contd

5. **Measuring costs & consequences**  
   – Used AR-DRG* 4.2 (2002-03) hospital cost data for each surgical procedure

6. **Valuing costs & consequences**  
   – Market costs used for all resources, leisure time not accounted for in this analysis

* Australian Public Sector
Drummond checklist contd

7. **Allowing for uncertainty**
   - Sensitivity analysis assesses effects of uncertainty of model parameters on outcomes modelled; i.e. robustness of results
   - Simulation & sensitivity analyses performed using @RISK© software
Analysis contd

• Bootstrapping technique utilised to simulate larger sample size (2000); confirmed initial findings

• Willingness to pay (WTP) may represent user’s own measure of benefit, where benefit =$$ for marginal user

• But, WTP may be a function of income.
Analysis contd

• This initial work focussed on costs & benefits of changes in treatment options & associated costs to parents & families
• Net Present Value: value of a stream of net benefits to be received in the future - in current $$ value. If >1 there is a net social benefit.
• If this partial CBA produces a +ve NPV, then little need for more intensive approach since this study captures most of the costs whilst only a subset of the benefits is measured.
• Thus a +ve NPV would likely be larger with greater benefit measurement.
Results

• Response rate
  – 55% for children’s parents
  – 67% for referring medical specialists
• 60% children-treatment options changed/deferred post-3DGA
• 30% children-pre-3DGA treatment option confirmed
• 10% children-3DGA for assurance
Results contd

- Average costs (analysis of musculoskeletal, temporospatial, kinematics, kinetics & electromyography data) estimated per patient for one condition only e.g. barefoot
  - $1280 excluding fixed costs, labour = $1006
  - $2125 including all fixed costs
- >1 condition e.g. +/- AFO’s then, costs = n conditions* analysis; normally only 1 m/s
Results contd

- Fixed costs decreases with increasing patient numbers, thereby reducing average cost.
- Some difficulty in capturing all costs in this preliminary study as some treatments will occur over a long duration.
Results contd

• Monte Carlo Simulation
  – Used when small amount raw data
  – Costs & benefits repeatedly calculated – each time using different randomly chosen set of values which are based on characteristics of each input variable’s probability distribution
  – Generates & saves these iterations (2000) to calculate NPV* for 130 or 260 patients p.a.

*Net Present Value
Results contd

• 67% benefits between $0-$3080
• 90% NPV estimates $1.4 million-$1.8 million
  – In other words, the benefits outweigh the costs by between $1.4 m-$1.8m, expressed in $2005
• To maintain positive NPV need >130 CGA p.a.
Discussion

• CBA methodology is widely used e.g. transport, environmental studies
• Many health studies are cost comparisons only- don’t measure benefits in $$
Conclusion

• CGA -not presently eligible for funding by Medicare Benefits Scheme
• Increasing referrals indicate perceived importance of CGA
• Little known about the true economic value of CGA
• CBA includes all costs/benefits irrespective of who bears/accrues them. If the net benefit is +ve, losers are compensated & society is better off.
Conclusion contd

• Capacity utilisation & capital intensity suggest that small cities e.g. Brisbane probably only support 1 CGA laboratory
The Future

• This study
  – Suggests that the benefits of CGA are greater than its costs
  – Recommends a larger study be undertaken to confirm the findings & include economic evaluation of outcomes e.g. functional improvement
  – Funding has been sought to address this issue.
Contact details

Dr Robyn Grote
Director
Queensland Children’s Gait Laboratory
Royal Children’s Hospital
robyn_grote@health.qld.gov.au
07 36361416