The Economic Costs of ADHD

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ADHD at a glance

» Affects 3 - 7% of school-aged children,\(^1\) with boys three times more likely to have it than girls\(^2\)

» Inheritable condition
  - 30 – 40% chance that a brother or sister will have ADHD\(^3\)
  - More than half of all parents with ADHD will have a child with ADHD\(^4\)

» Experts estimate that up to 60% of children with the disorder carry their symptoms into adulthood\(^5\)

» Reported impacts suggest that children with ADHD often have problems in their everyday lives beyond the core symptoms of the disorder itself\(^6\)
  - Low self-esteem\(^7\)
  - Emotional and social problems\(^8\)
  - Frequent underachievement at school\(^9\)
  - Inability to participate in social exchanges (e.g., sharing, cooperation)\(^10\)

1 DSM IV; 2,3 Faraone SV 2008; 4 Biederman 2003; 5 Weiss G 1993; 6 Escobar 2005; 7, 8, 9, NICE 2006; 10 Barkley RA 2002
ADHD: A Public Health Opportunity

- Prevalence: 4 – 12% in 37 countries

- Impairment
  - Smoking, drug use, health costs, driving, accidents, school performance, behavior, academic achievement, peer relations, parental functioning, divorce, work, unemployment, dysemployment, psychopathology, quality of life, adaptive skills, divorce

- Treatable
  - 75% response rates of core symptoms
  - Symptom improvement correlates with improved function
  - Treatment may prevent comorbidity, smoking, drug abuse, accidents
  - Treatment in childhood in a Finish study markedly decreased burden of illness in adulthood and capacity to function

Worldwide Prevalence in School Age Children

Site, Year

- Germany, 1990
- Ireland, 1991
- Puerto Rico, 1988
- New Zealand, 1987
- Ontario, 1989
- United Kingdom, 1991
- Switzerland, 1998
- Spain, 1995
- USA, 1996
- Brazil, 1999
- Netherlands, 2000

Criteria
- DSM-IV
- DSM-III-R
- DSM-III
- ICD-9

Prevalence

Faraone, 2004, World Psychiatry
Prevalence of Adult ADHD

**Childhood Epidemiology**
- 3 - 7% of school-aged children
- 60% continue to have impairment into adulthood
- Therefore 2 – 4.2% prevalence in adults

**Adult ADHD Epidemiology Studies**
- Murphy and Barkley 1996a 4.7%
- Murphy and Barkley 1996b 4.7%
- DuPaul, Weyandt et. al. 1997 4.5%
- Heiligenstein et. al. 1997 4.0%

Most quoted adult prevalence rate is 4% (7 million adults)

Age-specific Prevalence of ADHD Remission: *DSM-III-R* ADHD

Methylphenidate and Amphetamine Prescriptions

Source: IMS Health, National Prescription Audit Plus™
## Average Prevalence of ADHD Comorbidity

<table>
<thead>
<tr>
<th>Comorbidity</th>
<th>Est. Prevalence</th>
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</thead>
<tbody>
<tr>
<td>• Mood Disorder</td>
<td>19% - 37%</td>
</tr>
<tr>
<td>• Anxiety Disorder</td>
<td>25% - 50%</td>
</tr>
<tr>
<td>• Alcohol Abuse</td>
<td>32% - 53%</td>
</tr>
<tr>
<td>• Other Substance Abuse</td>
<td>8% - 32%</td>
</tr>
<tr>
<td>• Personality Disorder</td>
<td>10% - 20%</td>
</tr>
<tr>
<td>• Antisocial Behavior</td>
<td>18% - 28%</td>
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</tbody>
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Barkley et al., 1996a; Beiderman et al., 1993; Murphy & Barkley, 1996b; Roy-Byrne et al., 1997; Shekim et al., 1990
Impact of Untreated and Under-treated ADHD

Health Care System
- 50% ↑ in bike accidents\(^1\)
- 33% ↑ in ER visits\(^2\)
- 2–4X more motor vehicle crashes\(^3\-^5\)

School & Occupation
- 46% Expelled\(^6\)
- 35% Drop Out\(^6\)
- Lower Occupational Status\(^7\)

Society
- Substance Use Disorders: 2X Risk\(^8\)
- Earlier Onset\(^9\)
- Less Likely to Quit in Adulthood\(^10\)

Family
- 3–5X ↑ Parental Divorce or Separation\(^11\-^12\)
- 2–4X ↑ Sibling Fights\(^13\)

Employer
- ↑ Parental Absenteeism\(^14\)
- ↓ Productivity\(^14\)

References:
1. DiScala et al. 1998
2. Liebson et al. 2001
9. Pomerleau et al. 1995
ADHD: Social, Emotional, and Cognitive Consequences

- Repeat a Grade
- Teen Pregnancy
- Sexually Transmitted Diseases
- Substance Abuse
- Intentional Injury
- Incarcerated
- Fired from Job
- Attempt Suicide

% of Occurrence

0 10% 20% 30% 40% 50% 60%

Impact of Untreated ADHD on Academic Performance

More than $3 billion in annual public school expenditures

- Did not complete high school: 30%
- Retained in grade at least once: 50%
- Suspended at least once: 40%
- Expelled: 10%

Swensen, A et al. Publication Pending
Driving-related Outcomes in Adolescent and Young Adults

Nonmedicated ADHD (n=35) vs Control (n=36)

- Citations for traffic violations: P<0.05
- At fault for crash: P<0.001
- Multiple motor vehicle crashes: P<0.001

ADHD Adolescents and Driving

Increased likelihood of outcome compared with age-matched controls

- License suspended
- More speeding violations
- More violations
- Vehicle accident
- At fault
- Incur associated injuries
- More damage / injuries

Driving Impairments in Adults with ADHD

Department of Motor Vehicle Data

<table>
<thead>
<tr>
<th></th>
<th>ADHD (N=105)</th>
<th>Control (N=64)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Tickets</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Speeding Tickets</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Suspensions</td>
<td>*</td>
<td></td>
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<tr>
<td>MVA</td>
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*P<0.01.

Driving Performance in Adolescents with ADHD

- Randomized, crossover, single-blind study
- 6 male drivers with ADHD aged 16–19 years
- Comparison of equal doses of OROS® MPH (Concerta®) qd and MPH (Ritalin®) tid on driving performance
- Patients treated for 7 days on each regimen, then drove a driving simulator at 2, 5, 8, and 11 PM
- Primary outcome measure was Impaired Driving Score (IDS)


ED=emergency department.
ADHD: Cost of Medical Care

9-year median cost per person

1987 US Dollars

$5000

$4000

$3000

$2000

$1000

$0

Non-ADHD

$1944

ADHD

$4306*

1998 Average Costs per Patient and per Employee by Medical and Prescription Drug Claims and Work Loss

Swensen et al.
ADHD and Economic Burden

Swensen et al

1987 US Dollars

Control Families | ADHD Families | All Family Members in Control Family | Non-ADHD Family Members of ADHD Patients | Control Families | Non-ADHD Siblings of ADHD Patients

$1,220 | $2,461 | $1,407 | $2,518 | $473 | $825

ADHD and Economic Burden

Swensen et al
Sexual Behavior

- Longitudinal follow-up at young adulthood of a cohort of children (ongoing Milwaukee follow-up study) with ADHD compared with controls
  - Sexual intercourse at earlier age (15 vs 16 years)
  - More sexual partners (19 vs 7)
  - More pregnancies (38% vs 4%)
  - More sexually transmitted diseases (17% vs 4%)
  - Tested for HIV (54% vs 21%)

SUDs in Adolescents with ADHD

Overall Rate of SUDs (%)

- Nonmedicated ADHD (N=19): 75%
- Medicated ADHD (N=56): 25%
- Non-ADHD Control (N=137): 18%

*P < 0.001*
ADHD and Smoking in Adults

SUD Meta-analysis

Pooled Estimate of Odds Ratio

Stimulant treatment of ADHD in youth was associated with a 2-fold reduction in risk for SUD

*P<0.05; 95% CI for OR = 1.1–3.6.

Public Health Implications

High prevalence of ADHD in youths

High risk of youths with ADHD developing SUD

Identification and treatment of youths with ADHD may affect a large segment of the adolescent and young adult populations at risk for SUD.

Criminality and ADHD

» Conduct disorder and resulting antisocial disorders occur more frequently in patients with ADHD than controls
  - Coupled with an impulsive, high-risk lifestyle increases risk for legal problems

» Patients with ADHD are more likely to be
  - Arrested (39% vs 20%)
  - Convicted (28% vs 11%)
  - Jailed (9% vs 1%)

ADHD in Adult Prison Inmates

Portrait of the caregiver for an ADHD child
ADHD: Impairments in Socialization

» Children are stigmatized by their behavior
  • Troublemakers (bad sports)
  • Excessive talking
  • Cannot sit still
  • Unfocused, not responsive
  • Impulsive aggression

» Adolescents continue to demonstrate social problems
  • Poor participation in group activities
  • Few friends, limited opportunities
  • Vulnerable to antisocial groups, drug abuse, peer pressure
Is ADHD a Serious Public Health Concern?

- Prevalence
- Impairment
- Chronicity

Public Health Significance

Treatment Effectiveness
Cost of Illness: COI

» Cost to government
» Cost to the family
» Cost to the patient
» Opportunity cost
» Public health costs
» ADHD is expensive, creates suffering, impairs social productivity, and creates a public health risk to the public at large
Cost Adult ADHD

- Survey of 500 subjects with ADHD compared with 501 matched controls
- Annual US household income losses due to ADHD 77 billion/year
- $8,900 to $15,400 per year per household

Biederman J, 2008
Costs of Adult ADHD

» Less than 25% receive treatment\(^1\)
» Adults with ADHD incur high health care costs\(^2\)
» Adults with ADHD are at increased risk of asthma, depression, anxiety, bipolar, personality disorder, drug abuse, smoking
» Even after controlling for these conditions, the rates of inpatient, outpatient, prescription costs
» Health care cost of adult ADHD $5600 vs $2700 for controls\(^2\)
» Loss of work productivity\(^3\)

1 Faraone 2004; 2 Secnik 2005; 3 Swensen 2003
Cost Adult ADHD

» Excess per capita health care and work loss age 7 to 44 and family members

» Administrative claims data from a large company

» Total excess cost ADHD in 2000 in the US $31.6 billion
  ✷ 5% treatment of the condition
  ✷ 38% other health care costs
  ✷ 45% increased health care costs of family members
  ✷ 12% productivity losses of adult family members

1 Birnbaum 2005
Comparator Costs\textsuperscript{1}

- ADHD in children: 42.5 billion
- Depression: 44 billion
- Substance abuse: 180 billion

- BUT

- ADHD increases risk for these other diseases
- Prevalence > 5%
- Adult impact based on prevalence of 4.4% even greater

Pelham W 2007
Cost ADHD in Children

- Annual cost ADHD in children $14,600 per individual in 2005 US $
  - 18% health care
  - 34% education
  - 48% crime and delinquency
- 42.5 billion/year
- Comparable to asthma
- Increased risk ER visits, comorbidity, accidents

1 Pelham W 2007; Chan 2002; Leibson 2001, Swensen 2003
Cost of Childhood ADHD

- 13 studies, none Canadian
- Per unit cost medication has increased
- Prescribing has increased to include preschoolers, women, attention problems and adults
- No info on costs of new vs. old medications or their cost effectiveness
- Mental health treatment $2636
- Annual per child cost $5518
- Education $4900
- Crime $7040
- Total $14576

1 Guevara 2 Kelleher 3 Pelham 2007
Costs not accounted for

- Smoking$^2$
- Drug abuse$^3$
- Foster care
- Fetal alcohol and narcotic syndrome
- Victims of crime
- Victims of drug accidents
- Insurance rates
- Increased prevalence and adult prevalence 4.4% with 90% comorbidity$^4$
- Suffering to the individual, siblings, families, other children and teachers
- Decreased life expectancy$^1$

1 Barkley R 2 Pomerleau 3 Wilens T 4 Kessler R
Summary of US Cost Data

» Diagnosis increased from 1.4% (1979) to 9.2% (1996)$^1$

» Total costs of adult ADHD 31.6 billion year 2000 US$\(^2\)

» Total costs child ADHD 42.5 billion

» Loss of work productivity in adults $77 billion

» Total 74.1 billion

» Annual costs of ADHD children $14,600

» Total cost treatment 1.6 billion or 5%\(^2\)

We do not know?

- Current medication costs in Canada
- Patterns of insurance
- Cost effectiveness of new medications
- Cost of not insuring new medications – 4/6 provinces cover new medications
- Mean cost of non medication treatment in practice – MTA behavior therapy, parent training, summer camp and school consultation $6988/year
Excluded Indirect Costs

- Fetal alcohol/narcotic syndrome
- Life expectancy
- Damaged self concept
- Burden to siblings
- Foster care and adoption
- Welfare
- Child and spousal abuse
- Alcohol and drug abuse in parents
- Parental morbidity
Summary

» Cost of ADHD to health care, education, work, justice, social welfare system and driving insurance are exorbitant

» Cost of medication treatment approximates $1200, but with high rates of non-adherence

» Cost of psychological treatment approximates $400 - $1200 in practice

» The opportunity cost of non treatment greatly exceeds the cost of treatment
The economic problem

- Resources are scarce, wants or demands are infinite
- Individuals have to make choices or trade-offs
- Consumers have a budget constraint
  - budget = disposable income
  - balanced against prices and amount of goods/services consumed
- Consumers have preferences – they know what they like
  - Preferences reflect well-being obtained through consumption
  - Preferences are endowed & well behaved - axioms of choice
  - All choices are risky – expected utility theory

*Economics is the science of choice*
“Allocation of funds and facilities are nearly always based on the opinion of consultants but, more and more, requests for additional facilities will have to be based on detailed arguments with ‘hard evidence’ as to the gain to be expected from the patient’s angle and the cost. Few could possibly object to this.”

Generic steps economic evaluation

(1) Define study question and perspective
  - Describe alternatives, determine study perspective

(2) Identify, measure and value costs and benefits
  - Measure costs and benefits in physical units relevant for study perspective, value costs and benefits

(3) Analysis of costs and benefits
  - Discounting, incremental (additional) costs and benefits of alternatives, sensitivity analysis on key parameters

(4) Decision rule
  - Incremental Cost-Effectiveness Ratios (ICERs) e.g. cost per LYG or QALY thresholds, other decision-making criteria
Types of economic evaluation

» Cost-Effectiveness Analysis (CEA)
  ◦ Benefits not explicitly valued - natural units used e.g. Life Years Gained (LYG) or cases detected

» Cost-Utility Analysis (CUA)
  ◦ Benefits valued – typically based on LYG weighted by an index of Quality of Life – Quality Adjusted Life Years (QALYs)

» Cost-Benefit Analysis (CBA)
  ◦ Benefits valued - based on monetary valuations of health improvements and expressed in dollars
Quality Adjusted Life Years (QALYs)

1.00 Full Health
0.75
0.50
0.25
0.00 Dead

Dead

Full Health

Poor Health
Quality Adjusted Life Years (QALYs)

Life Years Gained = 6
QALYs Gained = 8.8
Health Economics of ADHD

- ADHD is severely impairing
- It endures
- ADHD patients remain impaired from infancy to old age
- QALY will be very high
- Treatments are efficient, efficacious and effective
- ICER/QALY in ADHD favours provision of optimal treatment
Steps to Change

» Recognize ADHD as common, impairing, and treatable
» Identify current services
» Identify where there are no services
  ➤ There is not a single centre of excellence for ADHD in adults in Canada
» Assign responsibility to care
» Develop interministerial services
» Example: National Institute for Health and Clinical Excellence has produced a practice guideline which mandates centres of excellence for ADHD throughout the UK including adult ADHD
Research Objectives

- Measure direct and indirect costs of ADHD in Canadian dollars
- Measure current pharmacoepidemiology of treatment
- Identify epidemiology of what patients are receiving and compliance with treatment
- Identify patterns of insurance provision in Canada
- ICER/QALY of medication treatments using a health utility for ADHD\(^1\) based on the EurQoL-5D

1. Matza L 2004; Secnik K 2005;
Research Objectives II

» Develop a health utility for the Child Health Illness Profile, a more appropriate quality of life measure for ADHD in children\(^1\)

» Identify the psychiatric adverse events of medication

» Measure the functional impairment and actual adaptive skills of children and adolescents with ADHD

Raat H, 2002
Method

- 200 sequentially identified clinic children with no exclusionary criteria apart from understanding English

- Measures:
  - Child Health Illness Profile (quality of life – satisfaction, resilience, achievement, comfort, risk avoidance)
  - Adaptive Behavior Assessment System\(^1\)
  - Resource Utilization Questionnaire
  - Strengths and Difficulties Questionnaire\(^2\)
  - Pediatric Adverse Events Rating Scale\(^3\)
  - Diagnoses (K-SADS)

Analyses

- CUA of current medication treatment and patterns of treatment, treatment duration and persistence
- Direct and indirect costs of ADHD itself grouped by education, health, parental lost days of work, family costs, day care costs, tutors
- Adaptive skills
- Youth and parent report of impact on quality of life
- Correlation of ADHD with broad spectrum psychopathology
- Impact of ADHD on prosocial skills
Preparing the Future

» Data lock 2010
» ICER/QALY of ADHD treatment
» The social costs of ADHD
» The family costs of ADHD
» The personal burden to the child with ADHD
» Health utility of ADHD using EQ-5D and CHIP
Our Changing Social Context

- Canada Health Act
- Michael Phelps
- Mental Health Commission
- Evidence based health plans
  - Cohort expectations
Implications for allocation at federal and provincial levels

» Legitimates demands by public for expanded services within Canada

» Suggests mechanisms for rationalization of planning and delivery

» Optimistic approach to health care planning
  • Assumption that health care allocation will rise above politics
  • Health care allocation will rise above the stigma of mental illness

» ADHD is an orphan condition
  • Pediatric illness is the orphan of medicine
  • Mental illness is the orphan of health care
  • ADHD is the orphan of mental illness
  • Adult ADHD requires expertise in developmental disorders (pediatric) but is mandated to be serviced in the adult system
  • The ADHD child/adult never made a great poster boy until Michael Phelps
Drugs and Psychological Intervention

- Inability to purchase medically necessary drugs has allocation implications
  - Down-stream costs to system
    - increased hospitalization rate
    - increased acuteness at hospitalization
    - decreased productivity
    - Poor compliance

- Unavailability of drugs has allocation implications

- ADHD is a disorder of performance. It is a disorder of adaptive skills. Medication minimizes symptoms and provides the opportunity but not the guarantee for skill development
  - Pills do not build skills
Basic theses

» A just society has an obligation to provide health care services to its members in order to remove or minimize health-based differences that might otherwise prevent the members from taking equal advantage of the opportunities that are available within that society.

» Our health care system has to accommodate changes in disease, disease recognition, and emergent conditions
  - When PKU and CF became adult conditions it was initially serviced in pediatrics until adult services became available
  - When we had a SARS epidemic the health care system moved to accommodate the need
  - We cannot afford a stagnant budgetary process that does not reflect changing needs

» This means that provision for services in ADHD in pediatrics should include reasonable consideration of access to diagnoses with reasonable waits, school consultation, drug reimbursement, access to consultation for adults treated in primary care, and legally enforced adaptations for ADHD in schools and the work place.
Steps to Change

» Recognize ADHD as common, impairing, and treatable

» Identify current services

» Identify where there are no services
  « There is not a single centre of excellence for ADHD in adults in Canada

» Assign responsibility to care

» Develop interministerial services

» It is happening
  « National Institute for Health and Clinical Excellence has produced a practice guideline which mandates centres of excellence for ADHD throughout the UK including adult ADHD (Philip Asherson)
  « Holland has a national adult ADHD centre (Sandra Kooij) which provides consultation to a regional expert in each area