Estimating costs of health care for neurological conditions in Canada in 2031

Philippe Finès, PhD

May 28, 2015
Plan of presentation

- Project Background
- Description of POHEM-Neurological
- Examining the costs
- Results
- Discussion
Project Background

- June 2009
  - Health Minister announces 4-year $15 million National Population Health Study of Neurological Conditions (NPHSNC)
  - Co-managed by Public Health Agency of Canada and Neurological Health Charities Canada
- Several projects funded by NPHSNC to examine various aspects of neurological conditions
  - Prevalence, risk factors, institutionalization, caregivers
- Microsimulation project to examine future burden of neurological conditions
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NPHSNC Microsimulation project

**Purpose:**
- To examine the future health and economic impacts of neurological conditions over the next 20 years
- Bring together findings from many of the other NPHSNC-funded studies
  - Incidence, prevalence, institutionalization, caregivers
  - (But not the risk factors)

**The microsimulation team included**
- Analysts from Health Analysis Division of Statistics Canada
- and members of the Public Health Agency of Canada
- Model developed in consultation with clinical experts in neurological conditions, individuals with neurological conditions, their caregivers and other researchers
Microsimulation

- Simulation of individuals (“micro”) in a population and the way that their characteristics change over time
- POHEM (Population Health Model) is a dynamic continuous time, Monte Carlo microsimulation tool developed in the Health Analysis Division of Statistics Canada
  - Individuals are simulated from birth to death, one at a time
  - Birth and death rates calculated by Demographic Division of Statistics Canada
  - Open population (includes birth and migration)
  - Used to simulate and project several risk factors and health conditions for the Canadian population

The purpose is to
- Recreate the Canadian population at a given point in time
- Project future trends
  - Under existing conditions (base case)
  - Under specified scenarios
POHEM-Neurological: General Framework

- Objective: Create one general framework to examine the impacts of each of the seven priority neurological conditions
  - Models run separately for each priority neurological condition
- Competing priorities
  - Sufficiently complex to encompass the major life, health and economic impacts of each neurological condition
  - Not so detailed that we can’t find adequate data, or that the framework won’t be suitable for each priority neurological condition
POHEM-Neurological: Conditions modeled

- From the list of 15 neurological conditions identified by NPHSNC, the following 7 were modeled:
  - Alzheimer’s and other dementias
  - Cerebral palsy
  - Epilepsy
  - Multiple sclerosis
  - Parkinson’s disease and Parkinsonism
  - Traumatic brain injuries
  - Traumatic spinal cord injuries

- Excluded conditions:
  - Amyotrophic lateral sclerosis (ALS), Brain tumours, Dystonia, Huntington’s disease, Hydrocephalus, Muscular dystrophy, Spina bifida, Tourette syndrome
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Assigning Health Care Costs

- An objective of the models was to examine the economic impact of neurological conditions (NCs)
- Health care direct costs
  - Physician visits
  - Pharmaceutical costs
  - Hospitalizations
  - Home care
  - Rehabilitation hospitals
  - Long-term care institutions
  - Assistive devices
- Indirect costs were not included
Assigning Health Care Costs

- Costs were estimated from administrative data in Ontario and British Columbia,
  - By condition
  - By state (Incidence and Prevalence)
  - By sex and age group

- Base case considered
  - No inflation
  - No discount
  - 2010 Canadian $
Assigning Health Care Costs

Out-of-pocket expenditures were included in the Direct costs

<table>
<thead>
<tr>
<th>Out-of-pocket from the patient</th>
<th>Out-of-pocket from the caregiver</th>
</tr>
</thead>
<tbody>
<tr>
<td>Only for the persons with the NC</td>
<td>For all persons with or without the NC, but only when they have a caregiver</td>
</tr>
</tbody>
</table>

Typical expenditures

- Prescription and non-prescription (over-the-counter) medications
- Assistive devices such as mobility aids, agility aids or specialized equipment
- Rehabilitation therapy such as physical, occupational, speech or massage therapy
- Home care services such as health care, homemaker, or other support services

- Home modifications to accommodate a care receiver's needs
- Professional services for a care receiver's healthcare or rehabilitation
- Hiring people to help with a care receiver's daily activities
- Transportation, travel or accommodation because of care giving responsibilities
- Specialized aids or devices for a care receiver's use
- Prescription or non-prescription drugs for a care receiver's use
- Any other out-of-pocket expenses because of care giving responsibilities
Assigning Health Care Costs

- Problem of co-morbidities
  - People may have more than one health condition that sends them to a doctor or to hospital
  - How to disentangle co-morbidity-related costs from those due to the neurological condition?

- Solution: Use of a counter-factual population
  - “No neurological” population against which we compare costs
  - Net economic impact of a specific neurological condition
Plan of presentation

- Background
- Description of POHEM-Neurological
- Examining the costs

Results:
  - All the modeled Neurological Conditions

Discussion
Projected Prevalence Counts, All the modeled Neurological Conditions, Canada, 2011 and 2031

- Traumatic spinal cord injury
- Traumatic brain injury
- Multiple sclerosis
- Epilepsy
- Cerebral Palsy
- Parkinson’s disease and Parkinsonism
- Alzheimer’s disease and other dementias

Large prevalence increase for some conditions.
Total and mean per capita costs – All the Modeled Neurological conditions

- Total cost $million - Alzheimer and other dementias
- Total cost $million - Epilepsy
- Total cost $million - Cerebral Palsy
- Total cost $million - Multiple Sclerosis
- Total cost $million - Parkinson’s disease and Parkinsonism
- Total cost $million - Traumatic brain injuries
- Total cost $million - Traumatic spinal cord injuries
- Mean cost per capita - Alzheimer and other dementias
- Mean cost per capita - Epilepsy
- Mean cost per capita - Cerebral Palsy
- Mean cost per capita - Multiple Sclerosis
- Mean cost per capita - Parkinson’s disease and Parkinsonism
- Mean cost per capita - Traumatic brain injuries
- Mean cost per capita - Traumatic spinal cord injuries
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Results:
- Alzheimer and other dementias
  - Prevalence of persons diagnosed with the Neurological condition (based on hospital data)
  - Costs
    - Total costs
    - Mean costs (per capita)

Discussion
Estimated and projected prevalence of diagnosed Alzheimer’s disease and other dementias, both sexes combined.
Projected **total direct costs** among individuals with Alzheimer’s disease and other dementias, divided into base and additional components of total cost, by age.

Total direct costs of Alzheimer and other dementias (all ages, all sexes) amount to 10.8 billion $ in 2011, 14.6 billion $ in 2021, 21.4 billion $ in 2031.
Projected Mean costs per capita among individuals with Alzheimer’s disease and other dementias, divided into base and additional components of total cost, by age

Average cost per capita (all ages): $31 700
Additional cost per capita due to the condition: (max at age 40-45: $28 900, min at age 75-80: $21 100)
Main drivers for mean costs per capita in 2031, age 85+, sexes combined

Persons with Alzheimer disease and other dementias:
Mean cost per capita in 2031= $33,272

Persons without Neurological conditions:
Mean cost per capita in 2031= $10,463
What have we learned?

- Total direct health care costs (population level)
  - Are higher among persons without Neurological conditions
    - Because prevalence of neurological condition is relatively small
  - Vary according to sex and age group
  - Increase with time
    - Because population increases and ages
    - and there is a shift towards older ages

- Mean costs per capita
  - Are higher among persons with the Neurological condition
  - Vary according to sex and age group
  - Are stable with time within the sex and age group
    - Because we assumed no change in costs per year
## What have we learned?

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>The highest <strong>total costs</strong></td>
<td>the oldest age group (85+)</td>
<td>the oldest age group (85+)</td>
</tr>
<tr>
<td>The highest <strong>total additional costs</strong></td>
<td>the oldest age group (85+)</td>
<td>the oldest age group (85+)</td>
</tr>
<tr>
<td>The highest <strong>mean costs per capita</strong></td>
<td>the oldest age group (85+)</td>
<td>the oldest age group (85+)</td>
</tr>
<tr>
<td>The highest <strong>mean additional costs per capita</strong></td>
<td>the youngest age group with that Neurological condition (40-44)</td>
<td></td>
</tr>
</tbody>
</table>
What have we learned?

- Main drivers for mean costs per capita vary according to the presence or absence of the neurological condition.

<table>
<thead>
<tr>
<th>Persons with Alzheimer or other dementias</th>
<th>Persons without Neurological conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Long term care</td>
<td>1. Hospital</td>
</tr>
<tr>
<td>2. Hospital</td>
<td>2. Physician</td>
</tr>
<tr>
<td>3. Out-of-pocket of the caregiver</td>
<td>3. Drugs</td>
</tr>
</tbody>
</table>
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Discussion

- POHEM-Neurological is a family of microsimulation models (i.e. a “tool”) that allows for the estimation and projection of health costs for 7 priority neurological conditions

- Results produced on a specific neurological condition show that examining
  - total costs or mean costs per capita,
  - base or additional costs
lead to different stories
Discussion

- Results produced so far are based on base case (status quo)
  - No variation on costs in future years
  - Future demography of Canada based on most probable hypotheses
  - Assessment of costs based on comparison of neurological condition and counterfactual

- However, it is possible to run the models with specific scenarios
  - Discounting on costs
  - Other demographic hypotheses (high and low hypotheses from Demographic division of Statistics Canada)
  - Variation in incidence or mortality rates
References

  - Current and Projected Direct and Informal Care Costs among Canadians Diagnosed with Alzheimer’s Disease and other Dementias – A Microsimulation Study, *Forthcoming*

  - Development and implementation of microsimulation models of Neurological Conditions, *Health Reports, Submitted*

  - Alzheimer’s and other dementias in Canada 2011 to 2031: a POHEM microsimulation modelling study of projected prevalence, health burden, health services and caregiving use, *Forthcoming*

- Public Health Agency of Canada
  - Mapping Connections – An understanding of Neurological Conditions in Canada, September 2014

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The team

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Merci – Thank you!
(APPENDICES)
POHEM-Neurological: General Framework

- Birth
- Incidence of Neurological Condition?
- Caregiver?
- Long term care?
- Death

Health Status (HUI3)

Time

$$$ Health Care Costs $$$
# Parameters: Data Integration

<table>
<thead>
<tr>
<th>Module</th>
<th>Statistics Canada Data Sources</th>
<th>External Data Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographics</td>
<td>Historical births, deaths, and future population projections</td>
<td></td>
</tr>
<tr>
<td>Neurological: Incidence, mortality</td>
<td></td>
<td>Administrative health data (BC Ministry of Health)</td>
</tr>
<tr>
<td>Health status: General population</td>
<td>National Population Health Survey (NPHS)</td>
<td></td>
</tr>
</tbody>
</table>
| Health status: Neurological population | 2011 Survey on Living with Neurological Conditions in Canada (SLNCC)  
- 2006 Participation and Activity Limitations Survey (PALS) |                                                                       |
| Caregiving & care receiving     | 2012 General Social Survey (GSS) – Caregiving and Care Receiving                               |                                                                       |
| Long term care                  |                                                                                              | Continuing Care Reporting System -- Ontario (University of Waterloo)    |
| Health care costs               |                                                                                              | Administrative health data from Ontario (ICES) & BC                     |
### CAREGIVING – Total out-of-pocket costs from caregivers

<table>
<thead>
<tr>
<th>Condition</th>
<th>2011</th>
<th>2016</th>
<th>2021</th>
<th>2026</th>
<th>2031</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alzheimer’s disease and other dementias</td>
<td>$1,212.1 M</td>
<td>$1,400.1 M</td>
<td>$1,631.3 M</td>
<td>$1,947.5 M</td>
<td>$2,369.2 M</td>
</tr>
<tr>
<td>Parkinson’s /Parkinsonism</td>
<td>$ 214.2 M</td>
<td>$ 249.0 M</td>
<td>$ 291.9 M</td>
<td>$ 348.4 M</td>
<td>$ 408.4 M</td>
</tr>
<tr>
<td>Cerebral Palsy</td>
<td>$ 204.5 M</td>
<td>$ 216.1 M</td>
<td>$ 231.7 M</td>
<td>$ 249.5 M</td>
<td>$ 264.6 M</td>
</tr>
<tr>
<td>Epilepsy</td>
<td>$ 145.5 M</td>
<td>$ 158.7 M</td>
<td>$ 172.7 M</td>
<td>$ 185.1 M</td>
<td>$ 205.5 M</td>
</tr>
<tr>
<td>Multiple Sclerosis</td>
<td>$ 162.1 M</td>
<td>$ 186.1 M</td>
<td>$ 205.4 M</td>
<td>$ 223.8 M</td>
<td>$ 239.2 M</td>
</tr>
<tr>
<td>Hospitalized Traumatic Brain Injury</td>
<td>$1,001.5 M</td>
<td>$1,099.3 M</td>
<td>$1,201.1 M</td>
<td>$1,302.8 M</td>
<td>$1,415.6 M</td>
</tr>
<tr>
<td>Hospitalized Spinal Cord Injury</td>
<td>$ 86.6 M</td>
<td>$ 96.7 M</td>
<td>$ 106.6 M</td>
<td>$ 116.9 M</td>
<td>$ 125.2 M</td>
</tr>
</tbody>
</table>
Total costs of Alzheimer and other dementias (all ages, all sexes) amount to 10.8 billion $ in 2011, 14.6 billion $ in 2021, 21.4 billion $ in 2031.