The webinar, “Multimorbidity in Canada,” will begin shortly.

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CLSA Webinar Series

Multimorbidity in Canada

Philip St. John, MD

Noon to 1 p.m. ET | May 24, 2017

Many people have more than one chronic health problem. These diseases add up, and the combined effect is more important than the effect of any one problem alone. Using data from the Canadian Longitudinal Study on Aging (CLSA), this webinar will examine the relationship between disease combinations and if they are more common in older people, or in people with lower income and education.

Dr. Philip St. John is an associate professor and head of geriatric medicine in the Department of Internal Medicine at the University of Manitoba. He is an affiliate of the Centre on Aging at the University of Manitoba, and is the co-lead investigator of the CLSA Manitoba site. His research interests include rural health and epidemiology of cognitive impairment and depression.

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EPIDEMIOLOGY OF MULTIMORBIDITY

CLSA Webinar

P St John, L Torbiak, S Tyas, V Menec, R Tate, L Griffith, S Nowicki
CONFLICT OF INTEREST

- Thanks to Centre on Aging Grant for these analyses
- Thanks to Scott Nowicki
- No conflicts of interest except that I am in the high income group
81 year old lady, living in house for 40 years, daughter lives next door

Previously ADL independent; ADL dependent

Past Hx: DM2, HBP, macular degeneration, OA, IHD, CHF, CRF (Cr 250 range), falls, urinary incontinence, cognitive issues noted by family (never assessed)

Followed by GP and eight specialists
- Admitted with stroke – Lt weakness, slurred speech, falls
- tPA and transferred back to peripheral hospital
- Transferred for rehab
- Day 2 – worsening SOB – increased lasix
- Day 4 – 15L – transferred to third acute care hospital
- Diagnosed with BOOP – high dose steroids
• Came to a second (different) rehab site

• Survived the pneumonia, but did not rehab well

• Remained with substantial cognitive and functional deficits

• “She was lucky to survive the pneumonia”

• “No – she wasn’t”
• Planned to go home with home stroke programme follow-up

• Follow-up with 14 specialists

• Kept falling with SBP 90 vs symptomatic CHF

• Went home on palliative care programme, no specialists
MULTIMORBIDITY

- Described in Byzantine texts on ageing, c 300ACE
- Well described in clinical papers in UK in the 1940s
- Increasing attention
MEDICAL AND NURSING NEEDS

The medical staff of the department is available to treat all patients in the different parts of the scheme. Naturally patients in the initial-treatment ward need the most attention, with daily visits from the senior medical staff. About two-thirds of the patients have multiple pathological conditions. About 31% (with seasonal variations) have acute illnesses. A further 28% have acute illnesses in addition to long-term disorders, and these patients tend to remain longest in the initial-treatment ward. If it seems
Physical Findings

Our most striking observation was the frequency of multiple disabilities. Men had a mean of 3.26 disabilities, of which 1.87 were unknown to the family doctor; women a mean of 3.42 disabilities, with 2.03 unknown (Table III). This finding is of great importance.

This is not a new idea

Williamson, Lancet, 1964
DEFINITIONS

- **Chronic disease**: health problems that require ongoing management over a period of years or decades.

- **Multimorbidity**: the coexistence of multiple chronic diseases and medical conditions in the same individual (usually defined as two or more conditions).

- **Co-morbidity**: any distinct additional entity that has existed or may occur during the clinical course of a patient who has the index disease under study.
Defined as ≥3 chronic diseases

Has distinctive cumulative effects for each individual

Associated with increased rates of:
- Death
- Disability
- Adverse effects
- Institutionalization
- Use of health care resources
- Impaired QOL
• Even when diagnosed with the same pattern of conditions, older adults with multimorbidity are heterogeneous in terms of:
  - Illness severity
  - Functional status
  - Prognosis
  - Personal priorities
  - Risk of adverse events

• Treatment options also differ

• So multimorbidity requires a flexible approach to care
IMPLICATIONS

- Need to move away from subspecialty based care
  - Complicated
  - Requires balancing

- Prognostication
Measurement

- Data source
  - Admin data
  - Clinical data
  - Self-report
  - Biomedical

- Time Frame
  - Point or period prevalence

- Included conditions
  - Risk factors
  - Symptoms and complaints
  - Double counting
  - Not counting

- Dichotomous or Continuous?

- Disease severity
Syndrome Overlap

Frailty

Disability

Comorbidity

Lally F, Crome P Postgrad Med J 2007;83:16-20
OVERLAP OF SYNDROMES

- Most people with frailty phenotype have disability and/or comorbidity

Theou et al, 2012
Figure 1. Number of chronic disorders by age-group

Epidemiology of multimorbidity and implications for health care, research, and medical education: a cross-sectional study
Supplementary figure S1: Number of conditions experienced by patients with common, important diseases

<table>
<thead>
<tr>
<th>Condition</th>
<th>0%</th>
<th>20%</th>
<th>40%</th>
<th>60%</th>
<th>80%</th>
<th>100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart failure</td>
<td>3</td>
<td>9</td>
<td>14</td>
<td>74</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stroke/TIA</td>
<td>6</td>
<td>14</td>
<td>18</td>
<td>62</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>7</td>
<td>13</td>
<td>16</td>
<td>65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coronary heart disease</td>
<td>9</td>
<td>16</td>
<td>19</td>
<td>56</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Painful condition</td>
<td>13</td>
<td>21</td>
<td>21</td>
<td>46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes</td>
<td>14</td>
<td>20</td>
<td>19</td>
<td>47</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COPD</td>
<td>18</td>
<td>19</td>
<td>17</td>
<td>47</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>22</td>
<td>24</td>
<td>19</td>
<td>35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cancer</td>
<td>23</td>
<td>21</td>
<td>17</td>
<td>39</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Epilepsy</td>
<td>31</td>
<td>23</td>
<td>16</td>
<td>29</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asthma</td>
<td>48</td>
<td>20</td>
<td>12</td>
<td>21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dementia</td>
<td>5</td>
<td>13</td>
<td>18</td>
<td>64</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anxiety</td>
<td>7</td>
<td>17</td>
<td>20</td>
<td>56</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schizophrenia/bipolar</td>
<td>13</td>
<td>21</td>
<td>21</td>
<td>46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depression</td>
<td>23</td>
<td>22</td>
<td>18</td>
<td>36</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 2. Prevalence of multimorbidity by age and socioeconomic status
On socioeconomic status scale, 1=most affluent and 10=most deprived.
Figure 3. Physical and mental health comorbidity and the association with socioeconomic status. On socioeconomic status scale, 1=most affluent and 10=most deprived.
Incidence of 3 conditions by age and gender:

- Men
- Women

The graph shows the incidence per 1,000 person-years increasing with age for both men and women. The incidence is higher for women than for men at all ages.
Three or more chronic conditions among adults 45+ years, 2004

Percent of poverty level
- Below 100%
- 100%-less than 200%
- 200%-less than 400%
- 400% or more

45-54 years

55-64 years

65-74 years

75+ years

Percent

0 10 20 30 40 50

SOURCES: Centers for Disease Control and Prevention, National Center for Health Statistics, Health, United States, 2006, Figure 15. Data from the National Health Interview Survey.
Common Disease Combinations

<table>
<thead>
<tr>
<th>Rank</th>
<th>Diseases present</th>
<th>Proportion of population with both diseases (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Arthritis, visual impairment</td>
<td>44</td>
</tr>
<tr>
<td>2</td>
<td>Visual impairment, high blood pressure</td>
<td>40</td>
</tr>
<tr>
<td>3</td>
<td>Arthritis, high blood pressure</td>
<td>34</td>
</tr>
<tr>
<td>4</td>
<td>Any heart disease, visual impairment</td>
<td>17</td>
</tr>
<tr>
<td>5</td>
<td>Visual impairment, hearing impairment</td>
<td>15</td>
</tr>
<tr>
<td>6</td>
<td>Any heart disease, arthritis</td>
<td>14</td>
</tr>
<tr>
<td>7</td>
<td>Any heart disease, high blood pressure</td>
<td>13</td>
</tr>
<tr>
<td>8</td>
<td>Arthritis, hearing impairment</td>
<td>12</td>
</tr>
<tr>
<td>9</td>
<td>Diabetes, visual impairment</td>
<td>12</td>
</tr>
<tr>
<td>10</td>
<td>Cancer, visual impairment</td>
<td>10</td>
</tr>
</tbody>
</table>

*aAmong 11 chronic conditions assessed (3 heart disease categories summed in 1 category).
*bWeighted to reference population.

L. P. Fried et al.
OUTCOMES OF MULTIMORBIDITY

• Death

• Reduced quality of life

• Reduced functional status

• Institutionalization
Cumulative probability of survival to age 85 by number of diseases diagnosed before age 75.

Robert B. Tate et al. The Gerontologist 2012; geront.gns050
“It’s fine to discover cures, but, remember, chronic conditions are our bread and butter.”

New Yorker
In the Manitoba Study of Health and Aging

St John et al, CFP, 2014
FUNCTIONAL STATUS

Number at risk

<table>
<thead>
<tr>
<th>Status</th>
<th>Number at Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>1087</td>
</tr>
<tr>
<td>Mild</td>
<td>450</td>
</tr>
<tr>
<td>Moderate/severe</td>
<td>214</td>
</tr>
</tbody>
</table>

Time (days)

- Good
- Mild
- Moderate/severe
Table 2: The association between multimorbidity and five-year mortality in community-dwelling older adults

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multimorbid conditions</td>
<td>1.09 (1.05, 1.12)</td>
<td>1.06 (1.02, 1.09)</td>
<td>1.04 (1.00, 1.08)</td>
<td>1.00 (0.96, 1.04)</td>
</tr>
<tr>
<td>Age</td>
<td>1.08 (1.06, 1.09)</td>
<td>1.07 (1.05, 1.08)</td>
<td>1.06 (1.04, 1.07)</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>0.53 (0.43, 0.64)</td>
<td>0.54 (0.44, 0.66)</td>
<td>0.50 (0.41, 0.62)</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>0.98 (0.96, 1.01)</td>
<td>1.01 (0.98, 1.04)</td>
<td>1.00 (0.97, 1.04)</td>
<td></td>
</tr>
<tr>
<td>Marital Status</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never married</td>
<td>ref</td>
<td>ref</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>0.82 (0.55, 1.23)</td>
<td>0.89 (0.59, 1.33)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Separated</td>
<td>1.30 (0.69, 2.46)</td>
<td>1.36 (0.72, 2.58)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Divorced</td>
<td>0.96 (0.64, 1.45)</td>
<td>1.03 (0.68, 1.55)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MMSE</td>
<td>0.94 (0.92, 0.97)</td>
<td>0.96 (0.93, 0.99)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CESD</td>
<td>1.01 (1.00, 1.02)</td>
<td>1.01 (0.99, 1.02)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Functional Status</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>ref</td>
<td>ref</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mild Impairment</td>
<td></td>
<td></td>
<td>1.80 (1.39, 2.33)</td>
<td></td>
</tr>
<tr>
<td>Moderate/severe</td>
<td></td>
<td></td>
<td>2.54 (1.91, 3.41)</td>
<td></td>
</tr>
</tbody>
</table>

CES-D is the Centre for Epidemiologic Studies – Depression scale; MMSE is the Mini-mental State Examination
Functional Status and Multimorbidity

Number of Problems

OARS (mean score)

Time 1

Time 2

Number of Problems
Number of Health Problems at Time 1

Status at Time 2

Functional Category

- No Decline
- Decline
- NH
- Dead

Number of Health Problems at Time 1
Multimorbidity In Canada

1. To describe the prevalence of MM in Canada

2. To determine if there are gradients in MM across social position

3. (To determine if diseases cluster together)
Analysis of the Canadian Longitudinal Study on Aging

- Prospective study of aging (Wave 1)
- As representative sampling frame as possible
  - Two cohorts – clinical component (not representative) and tracking cohort (representative)
  - Used trimmed data
- Aged 45 to 85
- 21 235 people in the “tracking cohort”
Measures

- Age
- Gender
- Social Position
  - Education category (note that education has dramatically increased in older Manitobans)
  - Individual Income (recoded)
  - Household Income (recoded)
  - Income Source
Measurement of Multimorbidity

• Self reported diseases

  • List of common conditions

  • We chose
    • Physical health (ie excluded mental health)
    • Included risk factors
    • Chronic in nature
Common Conditions
Overall

- Standardized the sample against the Canadian population of 2011

- Mean number of chronic conditions was 3.1 for the Canadian population age 45 to 85
Age, Gender and Multimorbidity
Age, Individual Income and MM

![Graph showing the relationship between age and mean number of conditions for different income levels.](image)
Age, Household Income and MM

The graph illustrates the relationship between age and the number of conditions (mean) across different household income categories. The x-axis represents age, ranging from 45 to 85 years, while the y-axis represents the number of conditions, ranging from 0 to 12. Five categories of household income are shown:

- <20,000
- 20-50,000
- 50-100,000
- >100,000

Each income category is represented by a different line color, allowing for comparison of trends across different income levels.
Gender, Income and MM

The diagram illustrates the relationship between personal income (in thousands) and the percentage of individuals with three or more conditions. The data are split by gender, with brown bars representing women and orange bars representing men. The chart shows a trend where the percentage decreases as income increases, indicating that fewer individuals with higher incomes have three or more conditions compared to those with lower incomes.
Gender and Education

![Bar chart showing number of conditions (mean) for different levels of education by gender (Women and Men). The chart indicates a trend where women have a higher number of conditions compared to men for each level of education.
### Results of Logistic Regression Models

Note that these are main effects models.

<table>
<thead>
<tr>
<th></th>
<th>Effect of Personal Income (Odds Ratio)</th>
<th>Effect of Household Income (Odds Ratio)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unadjusted</td>
<td>Adjusted</td>
</tr>
<tr>
<td>Income</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;20,000</td>
<td>3.35*</td>
<td>1.97*</td>
</tr>
<tr>
<td>20 – 50,000</td>
<td>2.51*</td>
<td>1.47*</td>
</tr>
<tr>
<td>50 – 100,000</td>
<td>1.46*</td>
<td>1.19*</td>
</tr>
<tr>
<td>100,000+</td>
<td>ref</td>
<td>ref</td>
</tr>
<tr>
<td>Age (per year)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender (ref = women)</td>
<td>0.64*</td>
<td></td>
</tr>
</tbody>
</table>
Logistic Regression

- 1.38 (1.21, 1.59) for those who did not complete high school;
- 1.03 (0.94, 1.14) for those who completed high school; and 1.18 (1.04, 1.36) for those with some post graduate education;
Interaction

• There is strong interaction between age and income on multimorbidity
  
  • The effect is attenuated in older groups
Social Position

- Strong social gradient across the spectrum of all measures
- More pronounced with income
INTERPRETATION

• Measurement of social position is problematic in late life
  • Retirement
  • Gender and retirement
  • Income versus wealth
• Life course effect
  • Persistent effect – “Allostatic load”
• Survivor effects
• Cohort, period and age effects of wealth and education, as well as exposure to societal inequality
Limitations

• Definition of multimorbidity

• Exclusion of acute illness and mental health diagnoses

• Inclusion of risk factors
CONCLUSIONS

• Social position affects the development of chronic illness

• The effect is strong and consistent within most societies, as here in the CLSA

• The effect may be attenuated in late life, or there may be a survivor bias
CONCLUSIONS

• Dichotomisation of MM may not be appropriate

• MM is extremely common in late life
IMPLICATIONS

- Need to review the models of care
  - Disease management versus individual care
  - Drug interactions
  - Prognostication for screening and aggressiveness of care
- Need to consider functional status and disease severity
MY THOUGHTS

- Likely will never have an “ideal” measure of MM
- Need to be flexible and consider the data at hand
- Need to be explicit about the measurement
- Findings very similar to Scotland (then and now!)
Factorial Invariance of the Centre for Epidemiological Studies Depression Scale (CES-D)
Megan O’Connell, Ph.D., R.D. Psych.

June 29, 2017 | 1 p.m. ET

Register: bit.ly/clsawebinars