Multimorbidity from Population Health to Primary Care in Canada

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My Journey with Multimorbidity

• Population/Public Health Perspective
• Measurement Issues
• Data Sources
• Primary Care Research
• Challenges and (Possible) Next Steps
Multimorbidity Burden in Canada

Age-standardized prevalence (\%) of the co-occurrence of two or more chronic conditions among people aged 40 years and over, by sex and province/territory, 2011/12

Data source: Public Health Agency of Canada, using Canadian Chronic Disease Surveillance System data files contributed by the provinces and territories as of April 2015. Alberta, Saskatchewan and Prince Edward Island data were unavailable.

(Feely A et al. Health Promotion Chron Dis Prev Canada 2017)
Multimorbidity Burden in Canada

Prevalence* (%) of the co-occurrence of two or more chronic conditions, by age group and province/territory, 2011/12

Data source: Public Health Agency of Canada, using Canadian Chronic Disease Surveillance System data files contributed by the provinces and territories as of April 2015. Alberta, Saskatchewan and Prince Edward Island data were unavailable.

(Feely A et al. Health Promotion Chron Dis Prev Canada 2017)
Figure 1. Distribution of the number of individuals with multimorbidity in Ontario across ages, by number of chronic conditions and year

(Koné Pefoyo et al. BMC Pub Health 2015)
Challenges in Multimorbidity Research

Feely et. al
Multimorbidity Framework (n=7):
• IHD
• Heart failure
• Asthma
• COPD
• “Mental Illness”
• Hypertension
• Diabetes

Koné Pefoyo et. al
Multimorbidity Framework (n=16):
• Arthritis
• Hypertension
• Asthma
• COPD
• Depression
• Diabetes
• Cancer
• Chronic coronary syndrome
• Cardiac arrhythmia
• Osteoporosis
• COPD
• CHF
• Renal failure
• Dementia
• Rheumatoid arthritis
• Stroke
• AMI
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Challenges in Multimorbidity Research

Prevalence\(^a\) (\%) of the co-occurrence of two or more chronic conditions, by age group and province/territory, 2011/12

Ontario estimates from Koné Pefoyo et al.
Study 1: Population Attributable Risk (PAR) on functional disability and social participation restriction of physical and mental chronic conditions individually and in combination

Data Source: Canadian Community Health Survey – Healthy Aging (Cross-sectional)
Population: Community-living men and women aged 45+ in Canada

(Griffith et al. J Epidemiol Comm Health 2017)
Population Attributable Risk

\[
\text{PAR\%} = \left(1 - \frac{\text{IP}_{\text{nonexposed}}}{\text{IP}_{\text{total}}}\right) \times 100
\]

where PAR = population attributable risk and IP = incidence proportion

- Assume that if the exposure could be eliminated, the incidence in the total population would be that of the nonexposed
- The proportion of the incidence of disability in the population that is due to exposure
**Table 2** Population attributable risk for activities of daily living disability by gender and age category

<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>Males</th>
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<th>Females</th>
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<td>45–54</td>
<td>IHD 18.7 (5.4 to 32.4)</td>
<td>IHD+RES 25.3 (9.9 to 41.1)</td>
<td>IHD+RES+DIA 29.6 (11.9 to 45.0)</td>
<td>DEP 8.8 (1.8 to 15.7)</td>
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<td>RES 6.8 (−5.1 to 19.0)</td>
<td>IHD+DIA 24.0 (7.8 to 39.7)</td>
<td>IHD+RES+HER 27.9 (12.6 to 43.3)</td>
<td>HER 1.2 (−2.5 to 5.0)</td>
<td>DEP+HER 10.0 (2.7 to 17.5)</td>
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<td>DIA 5.7 (−6.9 to 17.9)</td>
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<td>ART 0.01 (−8.9 to 9.9)</td>
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<td>HER 2.6 (−0.3 to 8.6)</td>
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<td>55–64</td>
<td>ART 16.9 (4.7 to 28.1)</td>
<td>ART+IHD 28.2 (15.9 to 40.7)</td>
<td>ART+IHD+DIA 34.6 (21.6 to 47.0)</td>
<td>ART 12.2 (1.3 to 23.0)</td>
<td>ART+DEP 19.9 (8.6 to 29.7)</td>
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<td>DIA 18.2 (10.1 to 26.5)</td>
<td>DIA+COG 22.4 (12.4 to 31.4)</td>
<td>DIA+COG+EYE 23.9 (13.0 to 34.0)</td>
<td>ART 36.9 (25.5 to 47.7)</td>
<td>ART+DIA 48.6 (38.8 to 57.3)</td>
<td>ART+DIA+EYE 55.3 (46.5 to 63.0)</td>
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- Impact of combinations of CCs on disability differ substantially by age and gender.
- Recognizing these differences will increase the efficiency of clinical and public health interventions.
Study 2: Examining population-level co-morbidity burden, patterns, and associated health service utilization and costs to inform intervention studies as part of the Aging Community and Health Research Unit (ACHRU)

Data Source: ICES Administrative Data
Population: Community-living men and women aged 66+ in Ontario with:
  - Diabetes
  - Dementia
  - Stroke

Insights on Multimorbidity from 3 Comorbidity Studies

Studies used a common methodology, time period and geographical area/health care system

Index conditions (Diabetes, Dementia, Stroke) differed in terms of:

- Prevalence
- Presentation
- Disease Course
- Population Demographics

(Griffith et al. BMC Health Serv Res 2019)
Insight 1: Patterns of Comorbidity

- **Hypertension**: 83%
- **Arthritis**: 61%
- **Ischemic Heart Disease**: 25%
- **COPD**: 23%
- **Diabetes**: 78%
- **Dementia**: 24%
- **Stroke**: 38%
- **Dementia**: 30%
Insight 2: Increase in HCU with Increasing Comorbidity Attributed to Non-Index Conditions
Insight 3: Drivers of Costs
Underscores the importance using a MM lens

• Co-morbidity a key driver of use
• Majority of health service utilization not attributed to care related to index condition
• Common patterns illustrate the underlying needs of people with multimorbidity that are often obscured in literature that has a single disease focus
Study 3: Explore how different frameworks and categories of chronic conditions impact multimorbidity prevalence estimates and associations with patient-important functional outcomes

Data Source: Canadian Longitudinal Study on Aging  
(Baseline data)  
Population: Community-living men and women aged 45-85 across Canada

(Griffith et al. JAGS 2019)
Multimorbidity Frameworks

Used 3 MM Frameworks developed base on systematic reviews of the MM literature

- Diederichs (at least 11 most common CCs diagnosed in people 65+)
- Fortin-prevalence (at least 12 most prevalent and/or impactful CCs)
- Fortin-20 (20 CCs based on relevance to primary care services, impact on patients, and how often included in other frameworks)
Multimorbidity Frameworks

Willadsen (identified most common diseases (10), risk factors (6), and symptoms (10) that were commonly included in frameworks

- Did not suggest a specific framework but highlighted the importance of considering what category of chronic conditions included in multimorbidity frameworks

- Used findings to categorize CCs from other frameworks into Diseases, Risk Factors or Symptoms
- Created Willadsen-D, Willadsen-DR, Willadsen-DRS
Multimorbidity Frameworks – Prevalence

A

Diederichs
(9 Diseases, 1 Risk Factor)

Fortin-Prevalence
(8 Diseases, 2 Risk Factors, 2 Symptoms)

Fortin-20
(10 Diseases, 3 Risk Factors, 6 Symptoms)
Multimorbidity Frameworks – Prevalence

B

Willadsen-D
(10 Diseases)

Willadsen-DR
(10 Diseases, 3 Risk Factors)

Willadsen-DRS
(10 Diseases, 3 Risk Factors, 6 Symptoms)

Prevalence, %

Age, y

45-54
55-64
65-74
75-85

50
100
0

Male 2+
Women 2+

Male 2+
Women 2+

Male 2+
Women 2+

20
30
40
50
60
70
80
90
100

Canadian Longitudinal Study on Aging
Étude longitudinale canadienne sur le vieillissement
Multimorbidity Frameworks – Associations with Patient Important Outcomes

**A Multimorbidity Framework**

- **Diederichs** OR (95% CI): 2.7 (2.5-3.0)
- **Fortin-Prevalence** OR (95% CI): 2.5 (2.2-2.9)
- **Fortin-20** OR (95% CI): 4.0 (3.4-4.6)
- **Willadsen-D** OR (95% CI): 2.6 (2.4-2.8)
- **Willadsen-DR** OR (95% CI): 2.7 (2.3-3.0)
- **Willadsen-DRS** OR (95% CI): 3.9 (3.2-4.7)

**A Multimorbidity Framework**

- **Diederichs** OR (95% CI): 4.4 (3.9-4.9)
- **Fortin-Prevalence** OR (95% CI): 4.1 (3.4-4.8)
- **Fortin-20** OR (95% CI): 6.4 (5.1-7.9)
- **Willadsen-D** OR (95% CI): 4.4 (3.9-4.8)
- **Willadsen-DR** OR (95% CI): 4.0 (3.4-4.7)
- **Willadsen-DRS** OR (95% CI): 6.2 (4.8-8.0)

Disability - OR (95% CI) for Disability

Self rated physical health - OR (95% CI) for Self-Rated Physical Health
## Multimorbidity Frameworks – Associations with Patient Important Outcomes

### Social Participation Restriction - OR (95% CI) for Social Participation Restriction

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<thead>
<tr>
<th>Multimorbidity Framework</th>
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<td>Diederichs</td>
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### Self rated mental health - OR (95% CI) for Self-Rated Mental Health

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Underscores the importance of what is included in a multimorbidity framework

- Risk factors generally increase prevalence but not associations with patient important outcomes
- Many MM frameworks do not include disease severity or symptoms. This may be important to include for patient important outcomes
- Inclusion of risk factors may be very important from a public health perspective (to prevent upstream causes of disease)
Key factors to consider when measuring multimorbidity

Study 4: Expert group of clinicians, researcher, and a policy-maker with expertise in the MM asked to consider the following questions focused on broader issues relating to measuring multimorbidity:

1) What important concepts should be included in measures of multimorbidity;

2) What key factors should be considered when creating measures of multimorbidity; and

3) What underlying concepts are currently missing in measures of multimorbidity

(Griffith et al. J Comorbidity 2019)
Factors associated with the choice of current MM measures

1) Fit with the Study Purpose
Multimorbidity measures are typically designed to serve specific purposes (e.g., epidemiological, clinical, policy, research), making it challenging to select a single "best" measure.

2) Conditions Included in Multimorbidity Measures
Inclusion of vague conditions and/or risk factors and symptoms in lists of conditions included in measuring multimorbidity run the risk of overestimating the prevalence of multimorbidity.

Deficiencies in current MM measures

3) Episodic Conditions
It is difficult to know whether to include, and how to include, episodic conditions in a multimorbidity measure, since these conditions go through long periods of remission and/or fluctuate significantly in terms of morbidity/severity.

4) Social Factors, Mental Health and Other Gaps
Current measures of multimorbidity do not incorporate social determinants of health, which are important drivers of multimorbidity and/or its consequences. There are other important gaps in current measures, such as the exclusion of mental health conditions.
Disability with and without Mental Health (Fisher et al.)

Odds of Disability (ADL, IADL) stratified by CC and Mood/Anxiety Adjusted for Age

Number of Chronic Conditions (CC’s)
Study 5: Explore agreement in multimorbidity measures between administrative (ICES) and self-report and understand factors associated with disagreement between the two data sources

Data Source: 4 Cycles of Canadian Community Health Survey (Cross-sectional Data) linked to ICES Administrative data

Population: Community-living men and women aged 45-85 across Canada

(Griffith et al. J Clin Epidemiol ; Gruneir et al. J Clin Epidemiol (Under Review))
Agreement

The chart shows the proportion of the cohort (%) for different numbers of chronic conditions (SR) with four categories: Perfect Agreement, Agree on # but not constituent CC, Agree, and Disagree. The graph indicates that as the number of chronic conditions increases, the proportion of the cohort that disagrees also increases.
Figure 1. Change in overall perfect agreement between self-reported chronic conditions and administrative records with removal of each chronic condition. Size of each circle represents the overall prevalence of each chronic condition with a larger size representing a greater prevalence. The shading if each circle represents the kappa matching statistic of each chronic condition with a darker shade representing a higher Kappa statistic.
Agreement on MM Status

![Graph showing Kappa values for different age groups and CCs counts](image-url)
Factors Associated with Agreement on MM Status

Factors

Sex: Male (vs Female)
Age: 45-54 (vs 85+)
55-64 (vs 85+)
65-74 (vs 85+)
75-84 (vs 85+)
Immigrant Status: Immigrant (vs Non-Immigrant)
Rurality: Rural (vs Urban)
Living Arrangement: With Someone (vs Alone)
Education: Post Secondary (vs No Degree/Diploma)
Secondary (vs No Degree/Diploma)
Income: $80,000+ (vs <$30,000)
$30,000-$79,000 (vs <$30,000)
Factors Associated with Agreement on MM Status

Factors

- **Smoking:** Occasional/Never (vs Daily)
  - Former ≥ 10 Yrs (vs Daily)
  - Former < 10 Yrs (vs Daily)

- **Physical Activity:** Active (vs Inactive)
  - Moderately Active (vs Inactive)

- **General Practitioner:** Do not Have (vs Have)

- **Physical Health:** Excellent/V. Good (vs Fair/Poor)
  - Good (vs Fair/Poor)

- **Mental Health:** Excellent/V. Good (vs Fair/Poor)
  - Good (vs Fair/Poor)

- **BMI:** >30 (vs ≤ 18.5)
  - 25 to < 30 (vs ≤ 18.5)
  - 18.5 to < 25 (vs ≤ 18.5)

- **Life Stress:** Not Stressful (vs Stressful)

- **IADLs:** Needs no Help (vs Needs Help)
Examining agreement for multimorbidity measures is complex.
  - Consider agreement on both the number of CCs and the constituent conditions.

The agreement between data sources decreased when the number of CCs increased.

The impact of individual CCs on multimorbidity agreement is influenced by both the agreement on individual CCs and its prevalence in the population.

Although many factors were associated with agreement, the associations appear to depend on the definition used to characterize multimorbidity.
Combining volunteers and primary care teamwork to support health goals and needs of older adults: a pragmatic randomized controlled trial

Lisa Dolovich PharmD MSc, Doug Oliver MD, Larkin Lamarche PhD, Lehana Thabane PhD, Ruta Valaitis PhD, Gina Agarwal MBBS PhD, Tracey Carr MBA RN, Gary Foster PhD, Lauren Griffith PhD, Dena Javadi MSPH, Monika Kastner PhD, Dee Mangin MBChB, Alexandra Papaloannou MD, Jenny Ploeg PhD, Parminder Raina PhD, Julie Richardson PhD, Cathy Risdon MD, Pasqualina Santaguida PhD, Sharon Straus MD MSc, David Price MD


ABSTRACT

BACKGROUND: The Health TAPESTRY (Health Teams Advancing Patient Experience: STRengthening Quality) intervention was designed to improve primary care teamwork and promote optimal gathered information on people’s goals, needs and risks in their homes, using electronic forms. Interprofessional primary care teams reviewed summaries and addressed issues. Participants intervention versus control group over 6 months (mean ± standard deviation [SD] 4.03 ± 3.86 v. 3.50 ± 3.53; difference of 1.52 [95% confidence interval (CI) 0.64 to 2.19]). The odds of having 1 or more hos-
Community Program Improves Quality of Life and Self-Management in Older Adults with Diabetes Mellitus and Comorbidity

Maureen Markle-Reid, RN, PhD, Jenny Ploeg, RN, PhD, Kimberly D. Fraser, RN, PhD, Kathryn A. Fisher, PhD, Amy Bartholomew, RN, BScN, Lauren E. Griffith, PhD, John Miklavcic, PhD, Amiram Gafni, PhD, Lehana Thabane, PhD, and Ross Upshur, MD, MSc

OBJECTIVES: To compare the effect of a 6-month community-based intervention with that of usual care on quality of life, depressive symptoms, anxiety, self-efficacy, self-management, and healthcare costs in older adults with type 2 diabetes mellitus (T2DM) and 2 or more comorbidities.

DESIGN: Multisite, single-blind, parallel, pragmatic, randomized controlled trial.

SETTING: Four communities in Ontario, Canada.

(SDSCA), Self-Efficacy for Managing Chronic Disease, and healthcare costs.

RESULTS: Morbidity burden was high (average of eight comorbidities). Intention-to-treat analyses using analysis of covariance showed a group difference favoring the intervention for the MCS (mean difference = 2.68, 95% confidence interval (CI) = 0.28–5.09, P = .03), SDSCA (mean difference = 3.79, 95% CI = 1.02–6.56, P = .01), and CES-D-10 (mean difference = −1.45, 95% CI = −0.13 to −2.76, P = .03). No group differences were seen in PCS.
Challenges and Possible Next Steps

• How do we move multimorbidity beyond # of chronic conditions?
  • Unified vs. Bespoke frameworks (Actionable)
  • Chronic condition clusters
  • “Big” data sources – EMR/administrative
  • Statistical methods to reducing dimensionality
  • Longitudinal data (like CLSA)

• How do we incorporate other important factors?
  • Examining other population stratifiers, such as SES, to better understand the heterogeneity in multimorbidity at the population-level
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- Maureen Markle-Reid (McMaster)
- Sohel Nazmul (McMaster)
- Kathryn Nicholson (Western)
- Doug Oliver (McMaster)
- Christopher Patterson (McMaster)
- Jenny Ploeg (McMaster)
- Parminder Raina (McMaster)
- Phil St. John (U Manitoba)
- Holly Tuokko (U Victoria)
- Ross Upshur (U Toronto)
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- Andrew Wister (Simon Fraser U)

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**McLaughlin Foundation Professorship in Population and Public Health**
References


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Questions?