Transforming Everyday Life into Extraordinary Ideas
Historians may well conclude that the most significant event of the 20th century was ...?

the growth of world population.
And in the 21st century, the most significant event may likely be ...?

the aging of humanity.
Gender and Aging

- NUMBERS
- MORBIDITY
- POVERTY
Trends in Global Aging

Percent of Population Aged 65 & Over: History and UN Projection

- Developed World
- Developing World

Source: UN (2005)
### Number of Years for Percent of Population Age 65 or Older to Rise from 7% to 14%

<table>
<thead>
<tr>
<th>More developed countries</th>
<th>Less developed countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>France 1865-1980</td>
<td>Azerbaijan 2000-2041</td>
</tr>
<tr>
<td>Sweden 1890-1975</td>
<td>Chile 1998-2025</td>
</tr>
<tr>
<td>Australia 1938-2011</td>
<td>China 2000-2026</td>
</tr>
<tr>
<td>United States 1944-2013</td>
<td>Jamaica 2008-2033</td>
</tr>
<tr>
<td>Canada 1944-2009</td>
<td>Tunisia 2008-2032</td>
</tr>
<tr>
<td>Poland 1966-2013</td>
<td>Thailand 2003-2025</td>
</tr>
<tr>
<td>United Kingdom 1930-1975</td>
<td>Brazil 2011-2032</td>
</tr>
<tr>
<td>Spain 1947-1995</td>
<td>Colombia 2017-2037</td>
</tr>
</tbody>
</table>

* Dates show the span of years when percent of population age 65 or older rose (or is projected to rise) from 7 percent to 14 percent.
Population Totals in Canada by Age Group and Year

<table>
<thead>
<tr>
<th>AGE</th>
<th>MALES</th>
<th>BOTH SEXES</th>
<th>FEMALES</th>
</tr>
</thead>
<tbody>
<tr>
<td>80+</td>
<td>229898</td>
<td>670192</td>
<td>440294</td>
</tr>
<tr>
<td>75-79</td>
<td>255599</td>
<td>622194</td>
<td>366595</td>
</tr>
<tr>
<td>70-74</td>
<td>364298</td>
<td>833991</td>
<td>469693</td>
</tr>
<tr>
<td>65-69</td>
<td>497996</td>
<td>1084588</td>
<td>586592</td>
</tr>
<tr>
<td>60-64</td>
<td>578596</td>
<td>1190087</td>
<td>611491</td>
</tr>
<tr>
<td>55-59</td>
<td>618096</td>
<td>1238387</td>
<td>620291</td>
</tr>
<tr>
<td>50-54</td>
<td>673295</td>
<td>1339986</td>
<td>666691</td>
</tr>
<tr>
<td>45-49</td>
<td>844194</td>
<td>1674182</td>
<td>829988</td>
</tr>
<tr>
<td>40-44</td>
<td>1076892</td>
<td>2138777</td>
<td>1061885</td>
</tr>
<tr>
<td>35-39</td>
<td>1173491</td>
<td>2344675</td>
<td>1171184</td>
</tr>
<tr>
<td>30-34</td>
<td>1311991</td>
<td>2597873</td>
<td>1285882</td>
</tr>
<tr>
<td>25-29</td>
<td>1282190</td>
<td>2528572</td>
<td>1246382</td>
</tr>
<tr>
<td>20-24</td>
<td>1067593</td>
<td>2108978</td>
<td>1041385</td>
</tr>
<tr>
<td>15-19</td>
<td>984993</td>
<td>1925780</td>
<td>940787</td>
</tr>
<tr>
<td>10-14</td>
<td>980292</td>
<td>1912979</td>
<td>932687</td>
</tr>
<tr>
<td>5-9</td>
<td>998293</td>
<td>1953079</td>
<td>954786</td>
</tr>
<tr>
<td>0-4</td>
<td>1000393</td>
<td>1953280</td>
<td>952887</td>
</tr>
</tbody>
</table>

1991 TOTALS 13938100 28117600 14179500
Hypothetical but Typical Scenario

• Mr. X who is 78 years old shows up for a visit at his doctors office and complains about severe Arthritis pain.
• Mr. X also has high blood pressure
• Mr. X is also overweight and has some foot problems
Challenges

• Clinical care is changing because of the increasing population of the older people

• Patients are complex and doctors see few patients a day

• Policy makers have to make decision at the population level to keep older people with complex needs maintain their function and independence.
  • Therefore want to know who are “at risk populations” and what policy interventions should be designed to promote independent living as long as possible
Physiologic reserve - Hypothetical Trajectory to Illness, Functional Limitation & Disability

- Younger age
- Older age
- Time

Physiologic reserve

- hip fracture
- pneumonia
- congestive heart failure

Functional limitation

Disability

Many chronic conditions
Multimorbidity

• Older adults are also at higher risk for multimorbidity (MM)

• MM is associated with increased disability and premature mortality, and health services utilization and costs

1St John, Can Fam Physician (2014)
2Lehnert, Med Care Res Rev (2011)
Definition and Burden of Multimorbidity (MM)

• Definition: the co-existence of two or more chronic conditions where one is not necessarily more central than the others

• MM represents a new and increasing challenge for the countries and their health and social care system.

• MM often has significant impact on: quality of life, increased functional disability and premature mortality.

• Currently no clear consensus on how to operationalize MM
  - Simple disease counts (# and type of CCs vary across studies)
  - Depending on definition prevalence of multimorbidity ranges from 13.1% to 71.8% in population-based studies
Impact of Multiple Chronic Conditions on Function (Griffith and Raina, 2012 Age & Ageing)

• We wanted to examine the relationship among chronic conditions, alone and in combination with physical limitations at a population level.

• To do this we calculated the population attributable risk (PAR) for individual and combinations of chronic conditions.
  • The PAR indicates the proportion of cases that would not occur in a population if the risk factor were eliminated
Methods

• Population: 9,008 community-dwelling individuals aged 65 and older participating in Canadian Study of Health and Aging (CSHA). CSHA participants were originally interviewed in 1991.

• Outcomes: ADL disability, IADL disability, and complex self-management disability (handling money, using the phone and self-medicating) as defined as needing help with or unable to perform one or more of the component activities.

• Chronic Conditions: Cognitive impairment, heart problems, diabetes, respiratory problems, hearing problems, vision problems, arthritis, foot problems,

• Potential Effect Modifiers and Confounders: Age, gender, marital status, education level, and living alone
Analysis

• **Selection of Chronic Conditions**
  - Chronic conditions that were prevalent
  - Independently associated with functional disability would be the most relevant from a public health perspective (i.e. associated with a higher PAR).

  • Present in at least 10% of the population and had a statistically significant relationship with functional disability

  • Model-based, adjusted estimations of PAR were computed to explore the population impact of selected chronic conditions on functional disability while adjusting for relevant covariates

  • PARs were calculated for individual and combinations of chronic conditions, ranked, and compared qualitatively.
# Population Characteristics of CSHA

## Stratified By Gender

<table>
<thead>
<tr>
<th>Population Characteristics</th>
<th>CSHA</th>
<th>CSHA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male (n=3,587)</td>
<td>Female (n=5,271)</td>
</tr>
<tr>
<td><strong>Age; mean (SD)</strong></td>
<td>74.7 (6.8)</td>
<td>76.3 (7.2)</td>
</tr>
<tr>
<td><strong># of chronic conditions; n (%)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>434 (12.1)</td>
<td>378 (7.2)</td>
</tr>
<tr>
<td>1</td>
<td>733 (20.4)</td>
<td>951 (18.0)</td>
</tr>
<tr>
<td>≥ 2</td>
<td>2,420 (67.4)</td>
<td>3,942 (74.8)</td>
</tr>
<tr>
<td><strong>Functional disability; n (%)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADL</td>
<td>349 (9.7)</td>
<td>1,015 (19.3)</td>
</tr>
<tr>
<td>IADL</td>
<td>1,029 (28.7)</td>
<td>2,368 (44.9)</td>
</tr>
<tr>
<td>CSM</td>
<td>367 (10.2)</td>
<td>645 (12.2)</td>
</tr>
<tr>
<td>Age Group</td>
<td>Males</td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td></td>
<td>2 Conditions</td>
<td>3 Conditions</td>
</tr>
<tr>
<td>65-74</td>
<td>FOOT+ART</td>
<td>46.5 (27.1, 65.9)</td>
</tr>
<tr>
<td></td>
<td>FOOT+IHD</td>
<td>43.1 (26.0, 60.1)</td>
</tr>
<tr>
<td>75-85</td>
<td>COG+VIS</td>
<td>40.7 (29.3, 52.1)</td>
</tr>
<tr>
<td></td>
<td>COG+ART</td>
<td>34.1 (19.4, 48.8)</td>
</tr>
<tr>
<td>≥ 85</td>
<td>COG+FOOT</td>
<td>44.1 (25.6, 62.5)</td>
</tr>
<tr>
<td></td>
<td>COG+VIS</td>
<td>39.7 (21.0, 58.5)</td>
</tr>
</tbody>
</table>

Where: ART= Arthritis, COG= Cognitive Impairment, DEP=Depression, DIA= Diabetes, EYE: Eye Disease, FOOT=Foot Problems, HBP= High Blood Pressure, HER= Hearing Impairment, IHD= Ischemic Heart Disease, RES= Respiratory Disease
CONCLUSIONS

• There was variation in magnitude and ranking of PARs by age, sex and definition of disability.

• Arthritis and foot problems in combination with other conditions was associated with largest PARs for disability.

• The PARs for cardiovascular conditions (ischemic heart disease and diabetes) also ranked high.

• Vision, hearing and cognitive impairment tended to be related to higher PARs for functional limitations in the older age groups.
THE IMPACT OF MM ON MORTALITY RATE ADVANCEMENT PERIODS IN OLDER ADULTS
(Raina, Gilsing et al. work in progress)

Canadian data were harmonized with several cohorts from Europe to maximize the sample size
METHODOLOGY

INCLUDED STUDIES:

• Canadian Study on Health and Aging (1991) n= 9008
• CHANCES consortium on Health and Aging n=18207 (EPIC Elderly (1992) n=10079; ESTHER study (2000) n=3842; Tromso study (1994) n=4286

EXPOSURE:

• Baseline information available for the following 5 prevalent, costly and preventable causes of death in high income countries:
  • Cancer, Stroke, Hypertension, Myocardial infarction, Diabetes
• Categorized into mutually exclusive groups of disease combinations
**OUTCOME:**
- All-cause mortality; Mean of 10y FU

**ANALYSES:**
- Cox proportional hazard models
  - adjusted for age, sex, tobacco smoking and education
  - Hazard \( (t, \text{exposure}) = b_1 \times \text{exposure} + b_2 \times \text{age} + \text{covariates} \)
- **Rate advancement period**
  - \( \text{RAP}=b_1/b_2 \)
  - specifies the loss of years in terms of mortality risk
Estimates of rate advancement period (RAP) for overall mortality associated with cluster of chronic diseases

Any 1 condition
- Cancer: 3.33
- MI: 4.18
- Stroke: 4.53
- Diabetes: 4.75
- HBP: 1.34

Any 2 conditions
- Cancer and MI: 5.56
- Cancer and stroke: 6.27
- Cancer and diabetes: 6.94
- Cancer and HBP: 4.06
- MI and stroke: 7.25
- MI and diabetes: 10.58
- MI and HBP: 4.65
- Stroke and diabetes: 5.68
- Stroke and HBP: 4.92
- Diabetes and HBP: 6.42

Any 3 conditions
- Cancer and MI and HBP: 10.02
- Cancer and stroke and HBP: 9.77
- Cancer and diabetes and HBP: 7.93
- MI and stroke and HBP: 6.78
- MI and diabetes and HBP: 9.74
- Stroke and diabetes and HBP: 10.18

Any 4 conditions: 11.13
RESULTS

• At baseline, >65% of participants reported having one or more chronic conditions hypertension being the most prevalent condition.

• The period by which the rate of death was advanced increased with each additional chronic condition.

• Compared with individuals without any of the five chronic conditions, the rate of death was advanced by 2.09, 5.56, 10.02, and 11.13 years for participants with 1, 2, 3, or ≥4 conditions, respectively.

• Among combinations with the same number of conditions, there was substantial variability in RAPs.

• Some disease combinations (e.g. cancer and stroke; RAP: 8.62, 95%CI: 4.79-12.49) had a significantly greater impact on the period by which the rate of death was advanced than others (e.g. cancer and hypertension; RAP: 4.06, 95%CI: 2.88-5.25).
Rate Advancement Period

 Specifies by which period the rate of death is advanced among people with a specific multi-morbidity relative to their disease free counterparts. For example, a 65 year old individual with 4+ chronic conditions has the same mortality risk as a 77 year old individual who has none of the five chronic conditions.
Implications for Researchers:
• Examining clusters and combinations of diseases requires very large and comprehensive data

Implication for clinicians:
• Knowing which combinations of conditions are associated with greater functional disability may help clinicians to target treatment strategies towards those conditions.

• Awareness of the PAR for single conditions and combinations of conditions in different genders at different ages, provides the opportunity for more precise targeting and management in that group.

Implications for policy makers:
• The PAR data for different demographic groups may help to develop preventive health strategies which target not only individual conditions, but clusters of diseases which share risk factors and together impact functional disability.
  • For example, obesity reduction through diet and exercise may reduce functional disability by decreasing the incidence of arthritis, and cardiovascular disease.
RESEARCH ON MULTIMORBIDITY AND COMPLEX PROCESSES OF AGING

• Large Population-based Studies that follow people over time are essential in order to sort causal relationships among demographic, biological, psychosocial and economic factors, and health (multimorbidity).

• Harmonization of data sets and cross-national comparison are important, considering variability across societies, in terms of status and well-being of older persons, experiences of health and mortality, family and social support, and health care systems.
Future Research on MM

Understanding Biological Pathways associated with Multi-Morbidity

(a) Specific metabolic and physiologic pathways, genetic and epigenetic influences on function and longevity
   - dietary and lifestyle exposures: levels of circulating fatty acids, carotenoids, antioxidant vitamins
   - inflammatory factors, hyperinsulinemia, and metabolomic profiles
(b) metabolic, physiologic, genetic, and epigenetic pathways between multimorbidity clusters
The Canadian Longitudinal Study on Aging (CLSA)

- A key strategic initiative of CIHR
  - The Canadian Longitudinal Study on Aging
- More than 160 researchers - 26 institutions
- Multidisciplinary - biology, genetics, medicine, psychology, sociology, demography, economics, epidemiology, nursing, nutrition, health services, biostatistics, population health
Canadian Longitudinal Study on Aging (CLSA)

A research platform – infrastructure to enable state-of-the-art, interdisciplinary population-based research and evidenced-based decision-making that will lead to better health and quality of life for Canadians.
Intrinsic and Extrinsic Factors

Environmental influences
(e.g., rural, socio-economic, exercise, nutrition)

Chronic diseases
(e.g., diabetes, cancer, dementia, arthritis, cardio)

Inflammation

Epigenetics
(e.g., telomeres/oxidative stress, psychological & cognitive abilities, immune functions)

Aging

Genetics

Health & Social Services Utilization

Time (Longitudinal Study)
50,000 women and men aged 45 - 85 at baseline

n=20,000
Randomly selected within provinces

n=30,000
Randomly selected within 25-50 km of 11 sites

Questionnaire
• By telephone (CATI)

Questionnaire
• In person, in home (CAPI)

Clinical/physical tests
Blood, urine (consent)
• At Data Collection Site

Interim contact, follow up every 3 years

Data Linkage (consent)
Participants (50,000)

Enrolled

Questionnaire Data (50,000)

Physical Exam and Biological Specimen (30,000)

Active Follow-up (F) Every 3 years
- Questionnaire
- Physical exam
- Biological samples

Maintaining Contact Interview (MC) mid-wave
- Update contact information
- Short Questionnaire

Passive Follow-up Every 3 years
- Health care utilization
- Disease registries
- Mortality databases

Data and Biological Sample Repositories

Researchers
Depth and Breadth of CLSA

PHYSICAL & COGNITIVE MEASUREMENTS
- Height & weight
- Waist and hip measurements
- Blood Pressure
- Grip strength, timed up-and-go, chair raise, 4-m walk
- Standing balance
- Vision (retinal imaging, Tonometer & visual acuity)
- Hearing (audiometer)
- Spirometry
- Body composition (DEXA)
- Bone density (DEXA)
- Aortic calcification (DEXA)
- ECG
- Carotid Plaque sweep (ultrasound)
- Carotid intima-media thickness (ultrasound)
- Cognitive assessment (30 min. battery)

HEALTH INFORMATION
- Chronic disease symptoms (disease algorithm)
- Medication and supplements intake
- Women’s health
- Self-reported health service use
- Oral health
- Preventative health
- Administrative data linkage health services & drugs & other administrative databases

PSYCHOSOCIAL
- Social participation
- Social networks and support
- Caregiving and care receiving
- Mood, psychological distress
- PTSD
- Coping, adaptation
- Injuries and consumer products
- Work-to-retirement transitions
- Retirement planning
- Social inequalities
- Mobility-lifespace
- Built environments & Contextual Factors
- Income, Wealth and Assets

LIFESTYLE & SOCIODEMOGRAPHIC
- Smoking
- Alcohol consumption
- Physical activity (PASE)
- Nutrition (nutritional risk and food frequency)
- Birth location
- Ethnicity/race/gender
- Marital status
- Education
Biospecimens
42 aliquots per participant
Analysis of Baseline Biomarkers

- We have completed Complete Blood Count on all fresh samples
- albumin, ALT, creatinine, CRP, ferritin, HbA1C, lipids panel, TSH, freeT4, Vitamin D on all 30,000 baseline participants
- Gene Wide Genotyping: Affymetrix UK Biobank Array on 10,000 participants
- Targeted age-associated CpG methylation on 5,000 participants
BASELINE DATA

• Completed on all 50,000 individuals

• First set of data have been released for analysis

• Remaining data will be available at the end of 2015 for researchers to analyze
DataPreview Portal

CLSA DataPreview Portal

Welcome to the DataPreview Portal for the Canadian Longitudinal Study on Aging (CLSA)! The CLSA data and biological samples are available to approved Canadian and international public sector researchers, with no preferential or exclusive access for any individual. As you navigate the site you will find information about the application process and requirements for data and sample access. If you are new to using the portal we recommend you begin by reading the Frequently Asked Questions.

- CLSA Overview
  Study design and documents

- Datasets
  Dataset from the baseline interview of 20,000+ Tracking participants

- Access
  Application procedure, required forms and data access policies
Follow-up-1 of the CLSA

Started in early 2015 and projected to be completed by early 2018
Follow-up One of the CLSA Contd…

- Child Maltreatment and adverse events
- Elder Abuse
- Epilepsy
- Decedent Information
- Workability
- Subjective Cognitive Decline and Meta Memory
- Preventive Health Behaviours
- Sexual orientation and Gender Identity
Future Research on MM

Understanding Biological Pathways associated with Multi-Morbidity

(a) Specific metabolic and physiologic pathways, genetic and epigenetic influences on function and longevity
   - dietary and lifestyle exposures: levels of circulating fatty acids, carotenoids, antioxidant vitamins
   - inflammatory factors, hyperinsulinemia, and metabolomic profiles
(b) metabolic, physiologic, genetic, and epigenetic pathways between multimorbidity clusters
Hypothetical but Typical Scenario in Family Practice

• Mr. X shows up for a visit at his doctors office and complains about severe Arthritis pain and wants medication.
• Mr. X also has high blood pressure
• Mr. X is also overweight and has some foot problems
• He is already on three medications
  • What should be the conversation between them?
  • What information Mr. X and his doctor should use to manage his multiple chronic conditions?
  • What are the implications of giving him another medication to control pain?
  • Where do they go and get most up to date information to make decision together?
Promoting the Use of Knowledge

- Good quality evidence
  - How do you know what is good quality?
    - Lots of Noise (Medical TV shows, internet)
      - Need to create tools that enables public, clinicians and policy makers to find signal from noise

- User friendly and accessible

- Available in multiple ways
McMaster
Optimal Aging Portal
McMaster Optimal Aging Portal

- Scientific evidence about how to stay healthy, active and engaged as we grow older
- A wealth of content specifically for citizens
- Additional content for clinical, public health and policy professionals
Key Content

Evidence Summaries, Web Resource Ratings, Blog Posts and Email Alerts
Evidence Summaries

• What are they?
  • Key messages from scientific research
  • Written in plain language

• Why are they useful?
  • Translated from our jargon
  • Ready to be acted on
Blood pressure-lowering drugs reduce cardiovascular events most in people with the highest initial risk

Review question
Do drugs that are used to treat high blood pressure reduce major cardiovascular events (e.g., stroke, heart attack, coronary heart disease) more in people who initially have a higher vs lower risk of those events?

Background
High blood pressure is usually defined as having a systolic blood pressure of 140 mm Hg or more or a diastolic blood pressure of 90 mm Hg or more. High blood pressure doesn’t always cause symptoms but can, over time, weaken or narrow blood vessels and cause strokes, heart attacks, or other heart problems.

Drugs that lower blood pressure can also reduce risk of cardiovascular events. They may work better in people who are initially at higher risk of cardiovascular events (e.g., older people, smokers, people with a family history of high blood pressure).

How the review was done
The researchers included data from 11 randomized controlled trials involving 51,917 people (average age 65 years, 45% women) in their analysis.

The key features of the trials were:
Web Resource Ratings

• What are they?
  • Evaluations of health resources on the internet

• Why are they useful?
  • Help you know which web-based resources are good
Alzheimer's disease: Can ginkgo products help?

Website: Informed Health Online

Summary

Gingko supplements (240 mg per day) may help reduce symptoms of Alzheimer's disease and enable you to perform daily tasks better. Be aware that gingko could interact with other medications, so talk to your doctor before taking any supplements.

Resource type - Article

View this Article
Blog Posts

- What are they?
  - Commentaries on what the research means
- Why are they useful?
  - Translated from our jargon
  - Presented in article format
Preventing the flu: Do vaccinations really work?
Influenza is a major cause of illness and vaccination is the most important strategy to prevent it and the complications that affect older adults, whose immune systems work harder to fight it.

What does drawing clocks have to do with driving cars? Tests of cognitive skills that can flag older drivers who may be unsafe behind the wheel
Problems with seniors’ driving have been linked to changes in their medical and functional status that are not related to normal aging changes. The key is to identify drivers who are at risk.

The benefits of exercise for older adults with dementia
Exercise may help older adults with dementia reduce functional limitations and improve overall physical functioning, making it easier to perform daily activities.
What the research tells us

While the diverse nature of the individual studies makes it difficult to draw concrete conclusions the following results were reported: the majority (16 of 20 studies) showed exercise to be effective in either reducing functional limitations (for example difficulty walking or climbing stairs) or improving overall physical functioning. Exercises performed at least twice a week produced the best results.

Healthy lifestyles, including good nutrition and regular exercise, are helping people live longer. But dementia remains a significant threat to the quality of those extended lives. A program of regular physical exercise may help improve mobility and other physical limitations of older adults with dementia. This might enable them to rely less on assistance from caregivers, possibly resulting in greater self satisfaction.

The Bottom Line

- Numerous studies have confirmed the benefits of regular physical activity for older adults, including the prevention of slips and falls.
- More recently, researchers have focused on the impact of exercise on seniors with dementia.
- Results to date suggest that physical exercise may help older adults with dementia be more mobile and better able to perform daily activities.
Content for professionals

• What is there?
  • Best evidence databases for:
    • Clinicians
    • Public health professionals
    • Policymaker

• Why are they useful?
  • See what the pros use
  • Outsmart your healthcare team
Email alerts

- What are they?
  - Lists of new content recently added to Portal
  - Weekly or monthly email you opt in for
- Why are they useful?
  - Click on hyperlink in email to view content of interest
  - Keeps you up to date with new research
Hypothetical but Typical Scenario in Family Practice

• Mr. X and his doctor independently gathered information from the portal and other credible sources and decided together that:

  • He will not be prescribed Arthritis pain medication at this time because these drugs could make his blood pressure worse. This could be more serious consequences for the individual

  • Based on evidence, they decided that they will work together to manage his arthritis through life style changes and that in turn may also help with his hypertension.
www.mcmasteroptimalaging.org
Thank You

Parminder Raina, PhD, CRC
McMaster University, Hamilton
Ontario CANADA

praina@mcmaster.ca