

# The webinar, “Heart Failure: The Perfect Storm in an Aging Society,” will begin shortly.

## For first-time WebEx users:

- Follow the instructions that appear on your screen and choose your audio preference (phone or computer). To change your audio settings at any point during the webinar, select Audio>Audio Conference from the main toolbar.
- The only people in the session who can speak and be heard are the host and panelists.
- If you have questions/comments, you can type them into the chat box in the bottom right of the WebEx window. Ensure “All Participants” is selected from the dropdown menu before you press “send.” Mobile users must select “Chat with Everyone.” Questions will be visible to all attendees.
- You can type your questions at any point during the session, but they won’t be answered until the end of the presentation.
- At the conclusion of the webinar, please remember to exit the WebEx session.

# CLSA Webinar Series



## Heart Failure: The Perfect Storm in an Aging Society

George Heckman, MD

Noon to 1 p.m. ET | April 27, 2017

Dr. George Heckman holds the Schlegel Research Chair for Geriatric Medicine at the University of Waterloo Research Institute for Aging, and is an associate professor with the School of Public Health and Health Systems at the University of Waterloo. He is an assistant clinical professor of medicine at McMaster University. He provides knowledge translation support for the Waterloo Wellington Local Health Integration Network. He has been primary panelist for the Canadian Cardiovascular Society Consensus Conference on Heart Failure since 2005 and vice-chair of the Quality Indicators for Heart Failure Working Group of the Canadian Cardiovascular Society.

Register online at <http://bit.ly/clsawebinars>

Webinars will be broadcast using WebEx  
Further instructions will be sent by email



[www.clsa-elcv.ca](http://www.clsa-elcv.ca)



# Heart Failure: The perfect storm in an aging society

**George A. Heckman MD MSc FRCPC**

RIA-UW Schlegel Research Chair in Geriatric Medicine

Associate Professor, School of Public Health and Health Systems, University of Waterloo

April 27, 2017

RESEARCH

EDUCATION

PRACTICE

Enhancing the quality of life and care of older adults through partnerships in *research*, *education* and *practice*.

**RIA** RESEARCH  
INSTITUTE  
*for AGING*  
Schlegel • UWaterloo • Conestoga

*Enhancing Life*

# What is heart failure?

Complex *chronic* syndrome in which abnormal heart function results in, or increases the subsequent risk of, clinical symptoms and signs of low cardiac output and/or pulmonary or systemic congestion.



# ACUTE VS. CHRONIC DISEASE

DISEASE TYPE	ACUTE	CHRONIC
ONSET	SUDDEN	PROGRESSIVE - LATENT SYMPTOM FREE PERIOD - SUDDEN “EXACERBATION”
COURSE	BRIEF	LIFELONG, PROGRESSIVE
RESOLUTION	USUALLY COMPLETE MAY LEAVE PERMANENT CONSEQUENCES	USUALLY NONE REMISSIONS AND RELAPSES
CARE		
- GOAL	CURE	PROLONG LIFE MAINTAIN QUALITY OF LIFE MAINTIAN FUNCTION REHABILITATION END-OF-LIFE CARE
- DURATION	BRIEF	LIFELONG
- COST	USUALLY MINIMAL	HIGH

# The Cardiac Cycle

**Ejection fraction:**  
proportion of blood  
volume pumped by the  
ventricle during each  
contraction

HF with Preserved Ejection Fraction

**HFPEF** (EF > 45-50%)

Left ventricle is too stiff to  
adequately *fill* in diastole

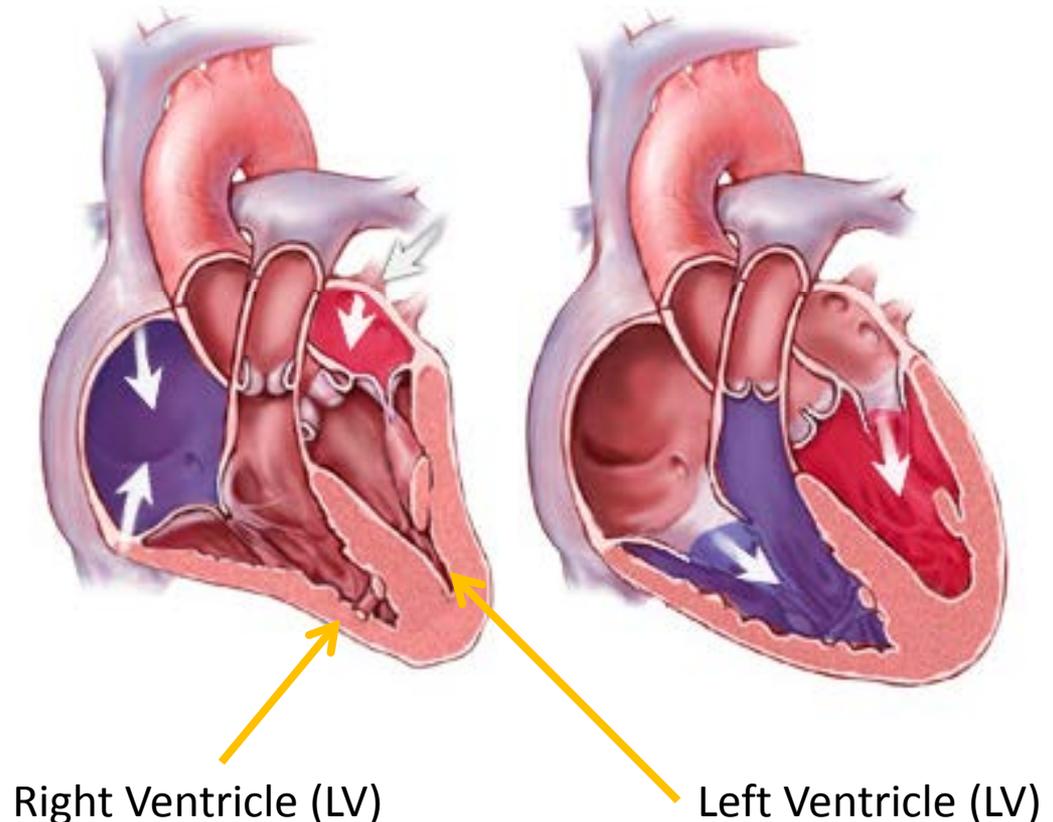
HF with Reduced Ejection Fraction

**HFREF** (EF < 45-50%)

Left ventricle is too weak to  
adequately *pump* in systole

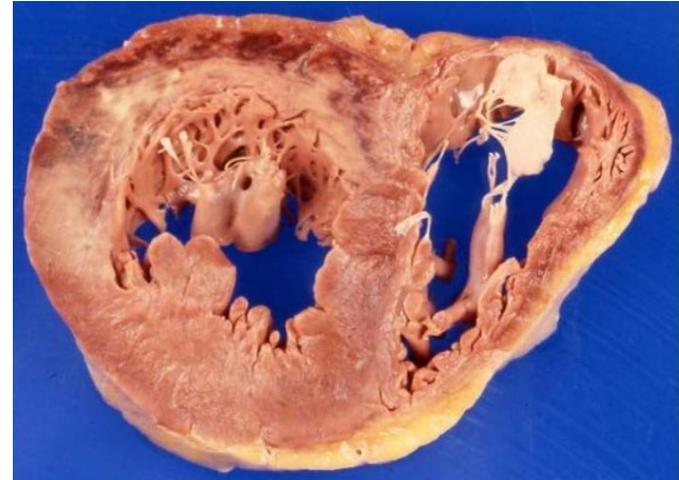
Systole

Diastole



# Why would heart function be abnormal?

- Coronary artery disease
- Hypertension
- Diabetes mellitus
- Viral cardiomyopathy
- Alcohol
- Chemotherapy
- Valvular heart disease



- ***Vascular ageing (more on this later)***

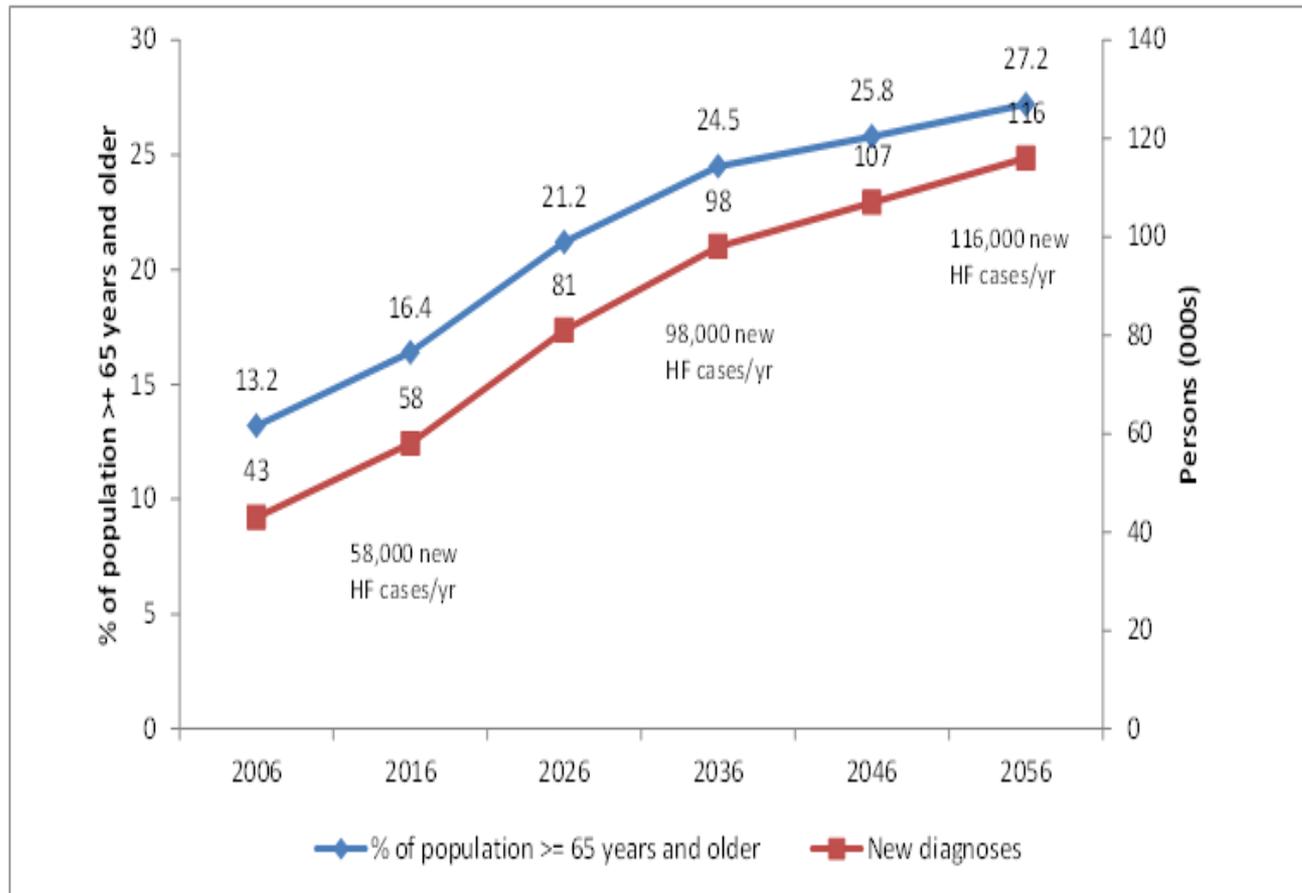
# Epidemiology

Bleumink Eur Heart J 04; Daamen et al 2009; Go et al 2014; Tran et al 2016

- Prevalence
  - Less than 65 years: 1%
  - 80 years+, long term care: 20%
- High mortality, morbidity, system use, cost
- Mortality after first hospitalization is 33% @ 1 year
  - over 60% if older, co-morbidities, dementia
- LTC mortality = 50% @ 1 year (90% if hospitalized)
- Most common cause of hospitalization in > 65 years
  - 3 month readmission rates 23% to 50%
- Inpatient costs: \$2.8 billion by 2030

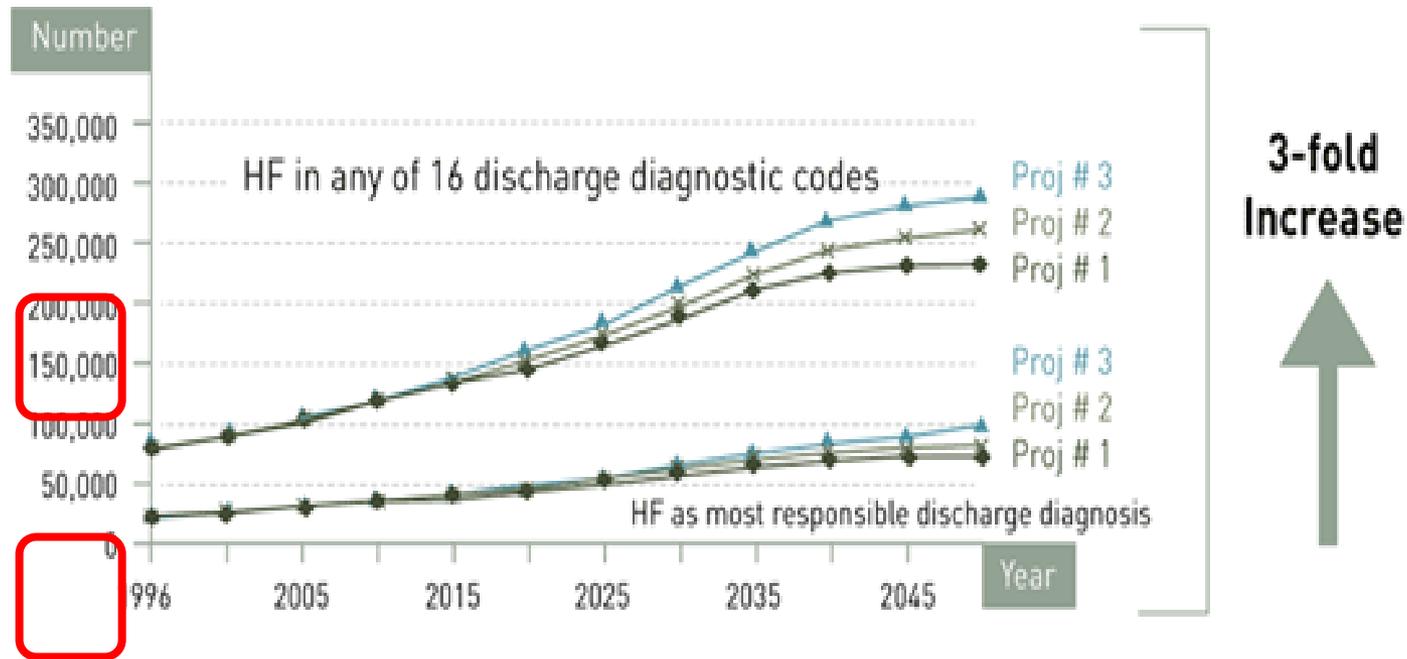
# The burden of HF is increasing

Figure 3: Projected Incidence of New Heart Failure Patients, Canada



Source: Adapted from Statistics Canada, Population Projections for Canada, 2005

# Projected HF Admissions in Canada



Johansen et al. Can J Cardiol 2003;19(4):430-5.

# Hospital Separations for HF and for all Other Causes, Canada (excludes Quebec), 2005-2006

	Heart failure	Other causes	Total
Number of people hospitalized	33,693	1,779,230	1,812,923
Number of hospital separations	42,399	2,415,128	2,457,527
Total number of comorbidities	166,084	5,589,258	5,755,342
Mean number of comorbidities* per separation	3.9	2.3	2.3
In-hospital mortality (% of separations)	13.3	4.4	4.6
Mean LOS* (d)	12.0	6.4	6.8

LOS, length of stay.

\* Significant difference (*t* test).

# HF treatments work but ...

Chen et al JAMA 2011

- HF mortality in the 1970s was ~ 50% at one year
- Declined gradually until recent decades but stalled
- Median survival 2 years
- Overall mortality @ 5 years is 50%
- Overall mortality @ 10 years is 99%
  
- Recent US Medicare/Medicaid trends

**Table 3.** One-Year Mortality Rates After Heart Failure Hospitalization, 1999-2008<sup>a</sup>

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
HF hospitalizations, No.	506 234	511 176	513 158	513 205	526 617	521 486	495 929	457 777	421 764	398 963
Overall rate, %	31.7	31.4	31.9	31.2	31.1	30.6	30.7	30.7	31.7	32.0
Rate by age, %										
65-74 y	23.8	23.4	23.4	22.5	22.4	21.7	21.4	20.9	21.7	22.0
75-84 y	31.1	30.5	31.1	30.5	30.1	29.6	29.3	29.1	30.1	30.3
≥85 y	42.3	42.4	42.9	42.4	42.6	41.9	42.4	42.2	43.0	42.7

# How did we get here?

- We created a health care system for acute disease
- We then “created” a chronic disease that is most common in older persons
- The population is aging

# The Evolution of the Canadian Health System

1957: **Hospital Insurance and Diagnostic Services Act** provided federal government cost sharing for public insurance for services offered in acute hospitals

1984: **Canada Health Act**: Provinces responsible for administration & delivery, how much money they will spend

Insured Services: Medically necessary hospital inpatient & ambulatory services

- Medically necessary = services provided by a physician in office, hospital or other settings

Services funded, at least in part, by provinces, but not covered by Canada Health Act:

- Drug Plans
- Home Care, Supportive housing
- Long-Term Care
- Non-hospital Rehabilitation



Added after the fact, piece-meal, **not** integrated

# Consequences

- System centered on hospital care and geared towards *acute* illnesses
  - Care processes (and fee schedule) designed to address acute problems
  - Clinician training mainly hospital-based, as opposed to community
- ***More on the system later...***

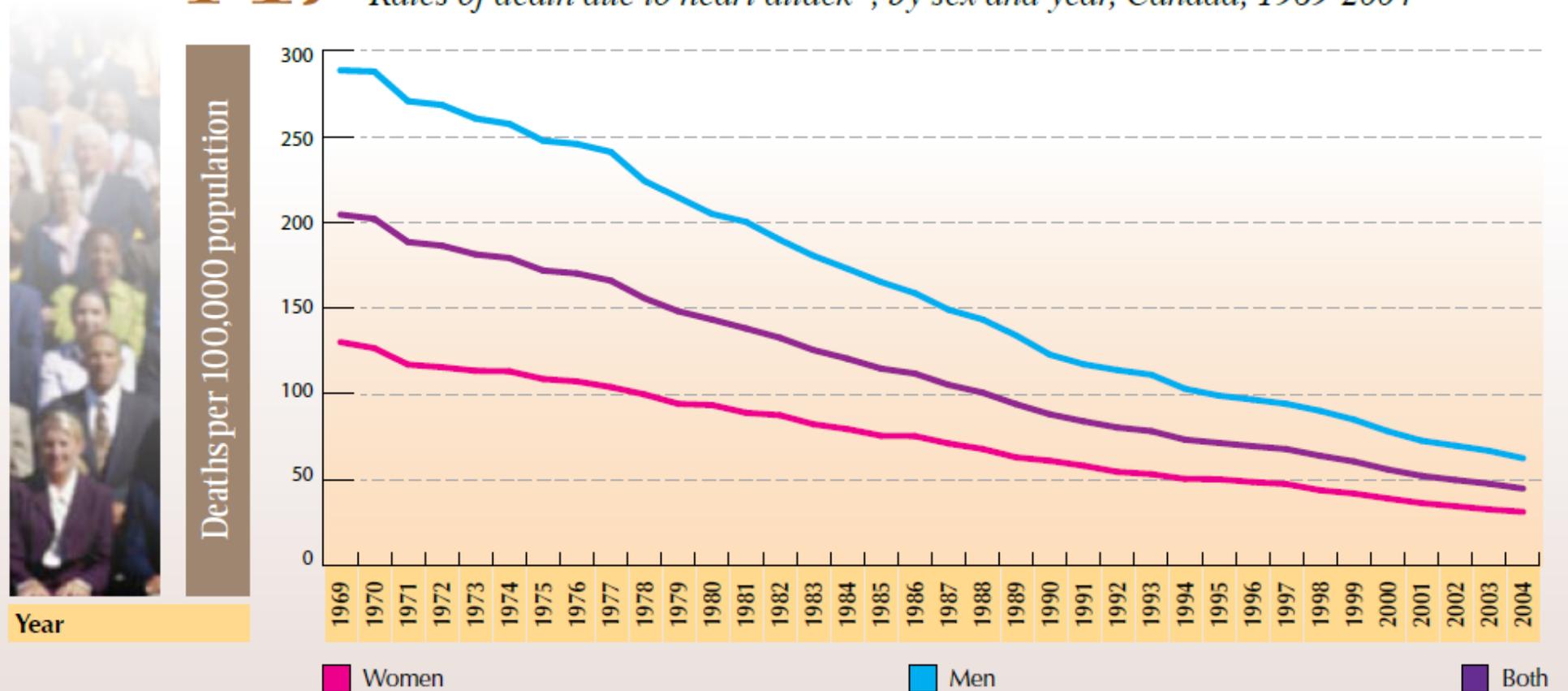
# Enter Evidence-based cardiology

- Hypertension control
- Better therapies for acute myocardial infarction and coronary artery disease
- Pharmaceuticals: statins, anti-platelet, ACE inhibitors
- Prevention: fall in smoking rates
- Rehabilitation

# CVD mortality has fallen substantially

Public Health Agency of Canada

**Figure 4-17** Rates of death due to heart attack\*, by sex and year, Canada, 1969-2004

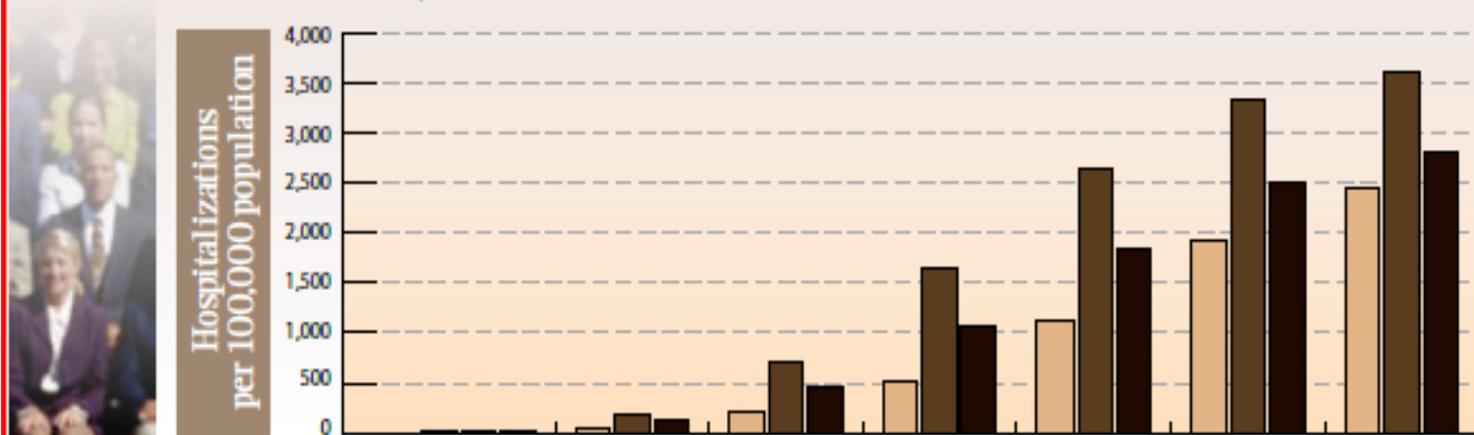


\* ICD-10-CA codes: I21-I22. ♦ Notes: - Standardized to the 1991 Canadian population. - The coding schemes for this condition changed in 1979 and 2000, and this may influence trends. ♦ Source: Chronic Disease Surveillance Division, Centre for Chronic Disease Prevention and Control, Public Health Agency of Canada, using data from the Vital Statistics Database (Statistics Canada).

# The price of success...

People living longer **with** cardiovascular disease

**Figure 4-4** Rates of hospitalization due to ischemic heart disease\*, by sex and age group, Canada, 2005/06

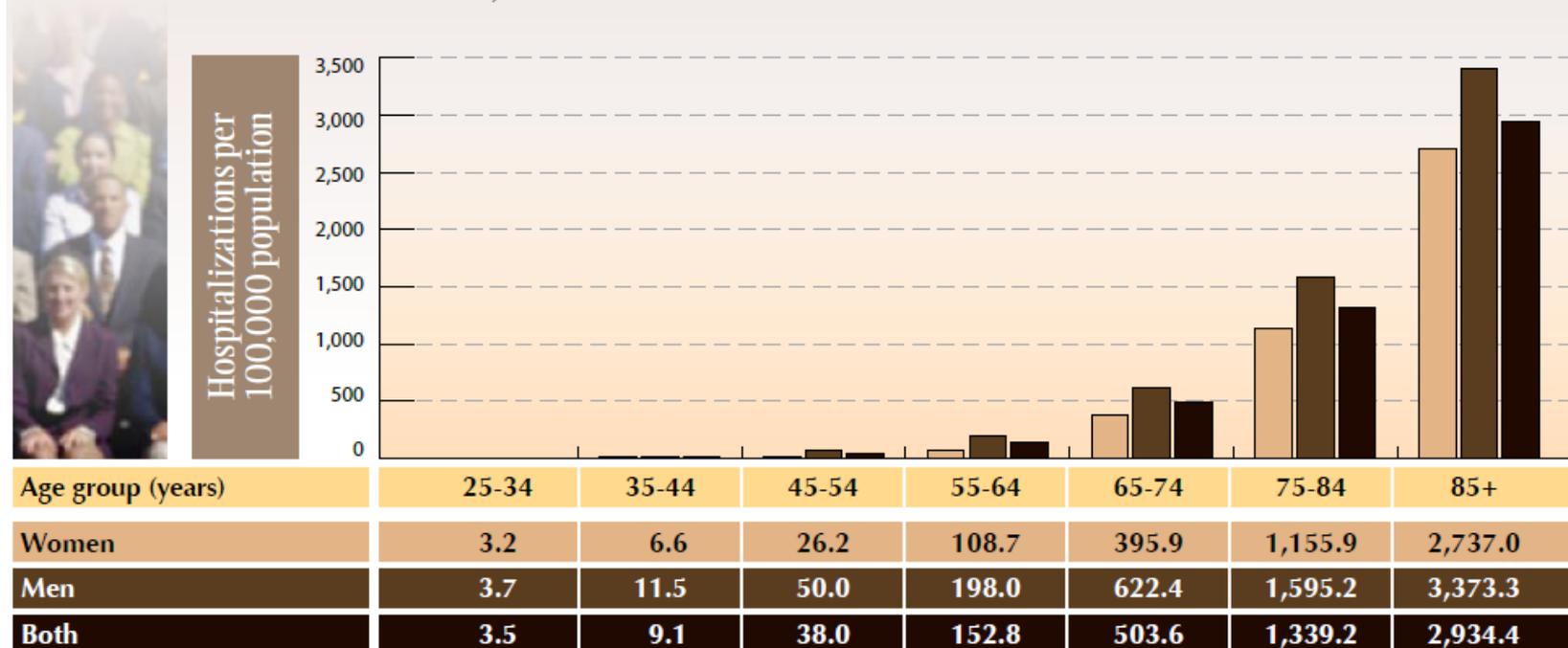


Age group (years)	25-34	35-44	45-54	55-64	65-74	75-84	85+
Women	5.5	52.1	197.5	507.1	1,124.0	1,923.7	2,443.7
Men	20.9	182.8	703.4	1,640.6	2,646.4	3,329.6	3,591.8
Both	13.3	117.8	449.0	1,066.0	1,848.3	2,510.5	2,800.2

♦ \* ICD-10-CA codes: I20-I25. ♦ Notes: - Hospitalizations are based on the most responsible diagnosis for the length of stay in hospital. - Québec data not available in 2005/06. ♦ Source: Chronic Disease Surveillance Division, Centre for Chronic Disease Prevention and Control, Public Health Agency of Canada, using data from the Hospital Morbidity Database (Canadian Institute for Health Information).

# ... and many live to develop heart failure...

**Figure 4-25** Rates of hospitalization due to congestive heart failure\*, by sex and age group, Canada, 2005/06



♦ \* ICD-10-CA code: I50. ♦ Notes: - Hospitalizations are based on the most responsible diagnosis for the length of stay in hospital. - Québec data not available in 2005/06.  
 ♦ Source: Chronic Disease Surveillance Division, Centre for Chronic Disease Prevention and Control, Public Health Agency of Canada, using data from the Hospital Morbidity Database (Canadian Institute for Health Information).

# To sum up...

- Evidence-based cardiology has led to significantly greater survival of persons affected with cardiovascular risk factors and cardiovascular disease
  - However, they are **NOT** cured of these
  - The grow old **WITH** these conditions
  - These conditions become **CHRONIC**
- Many eventually develop **CHRONIC** heart failure
- ***But what else happens as we age?***



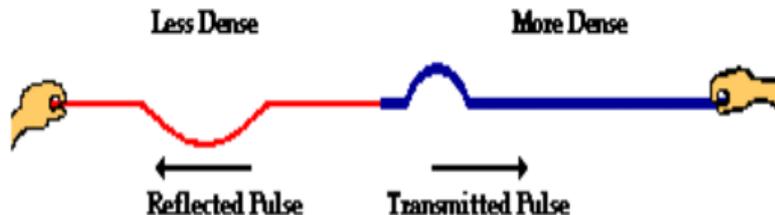
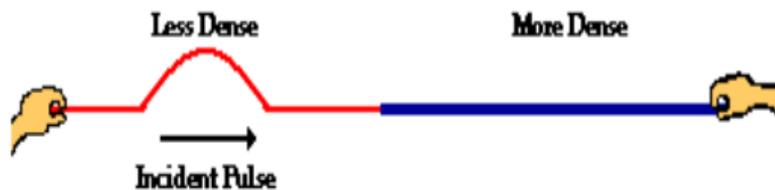
> **“A man is as old as his  
arteries.”***Thomas Sydenham, 1624-1689* <

Women too...

George Heckman, now

# First, a bit of wave physics...

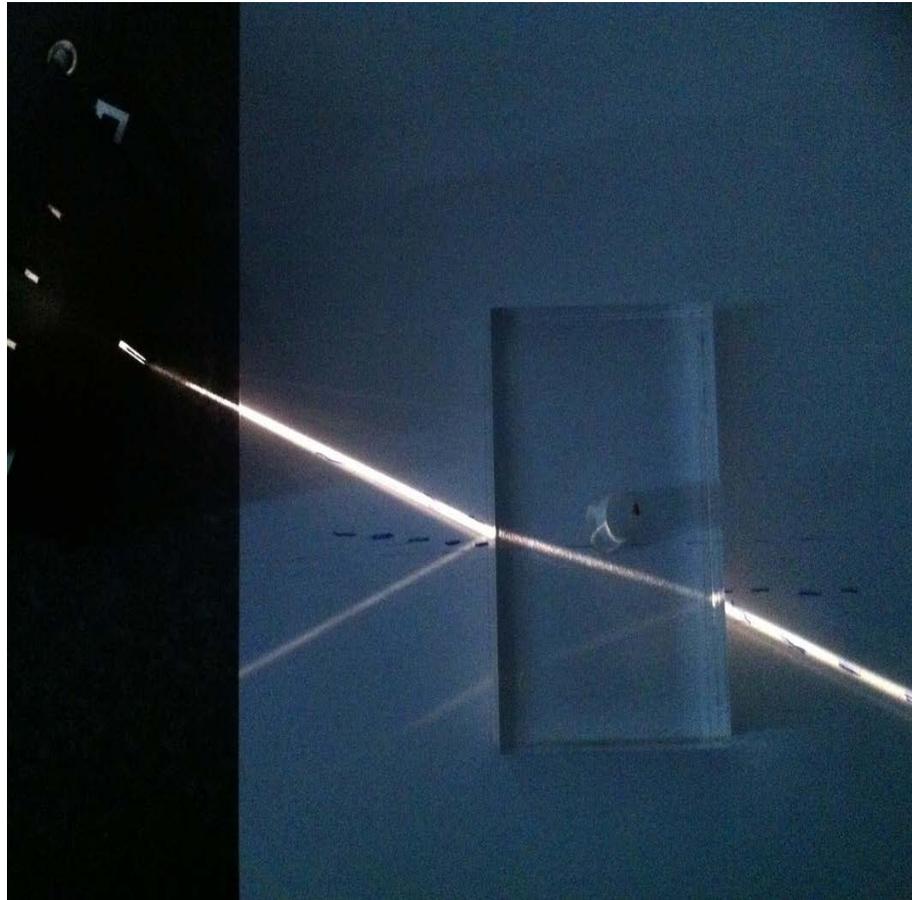
A wave traveling from a less dense to a more dense medium ...

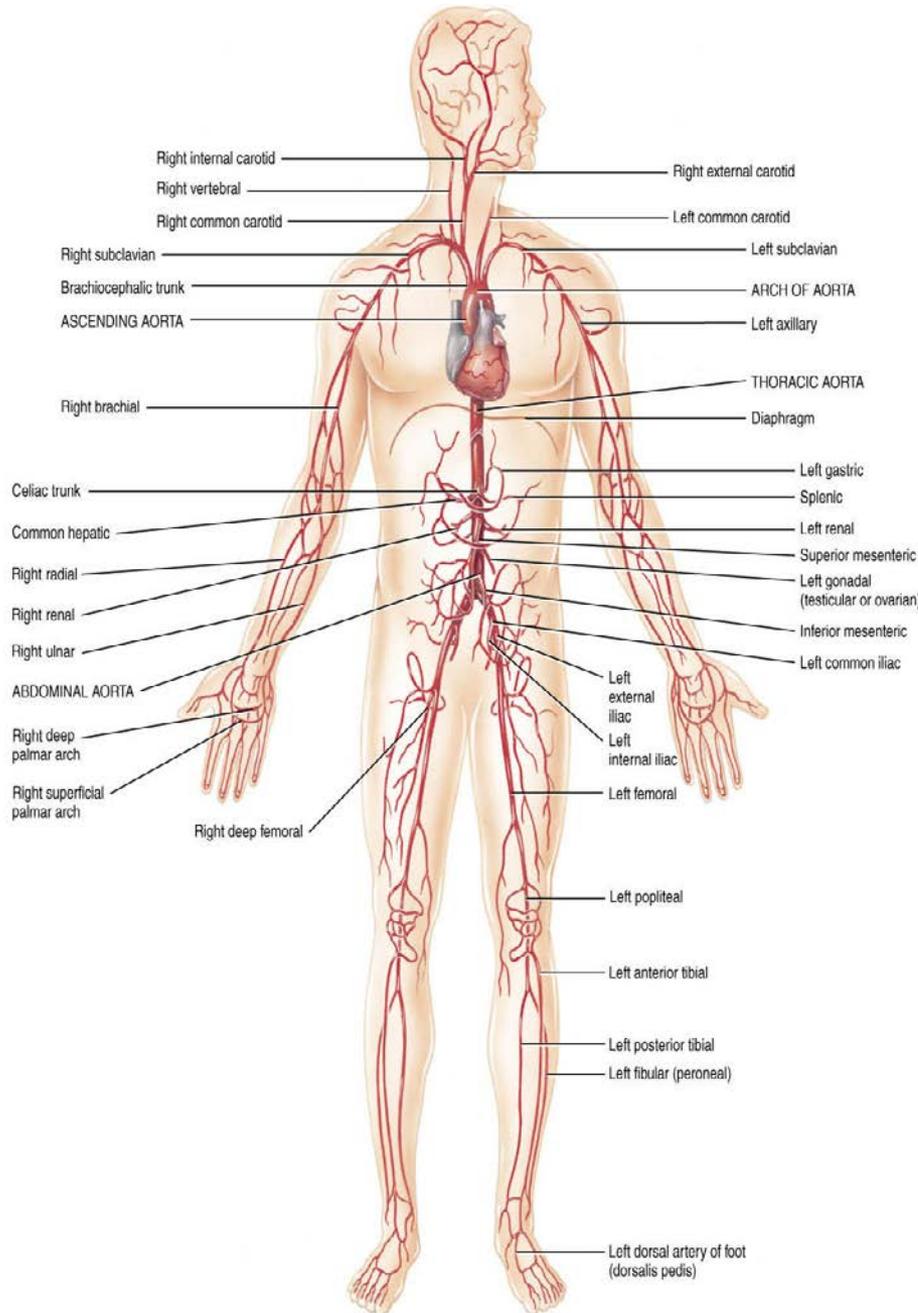


...will be reflected off the boundary and transmitted across the boundary into the new medium. The reflected pulse is inverted.

When the densities of the two media are closely matched, there is

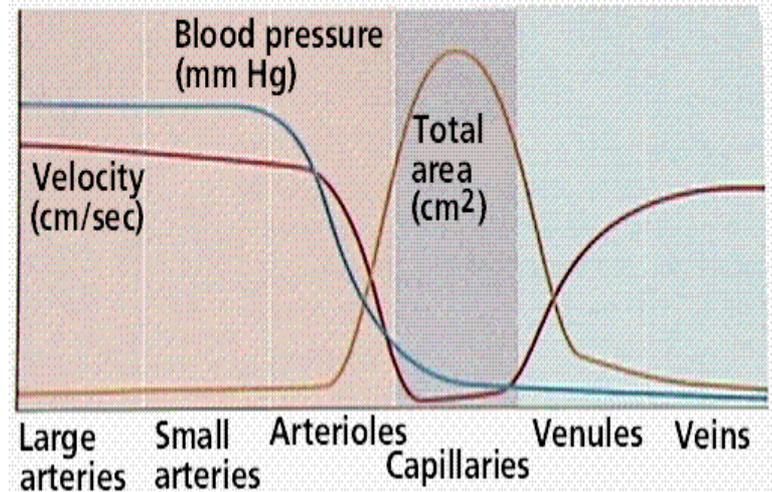
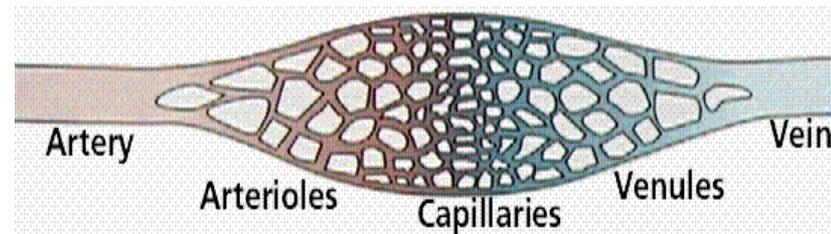
- More wave transmission
- Less wave reflection





Overall anterior view of the principal branches of the aorta

- Elastic arteries
  - Aorta and major branches
- Muscular arteries and arterioles
- Capillary bed



*Handwritten signature*

# Arteries are conduits for blood pressure waves

## Elastic arteries

- Major distribution vessels: aorta & major branches
- Walls contain elastin to accommodate blood ejected by heart

## Muscular arteries

- Include arms and legs
- Distribute and regulate blood flow more distally

## Arterioles

- Muscular vessels that **cushion/dampen** fragile capillary beds/organs from systemic blood pressures & mediate peripheral vascular resistance

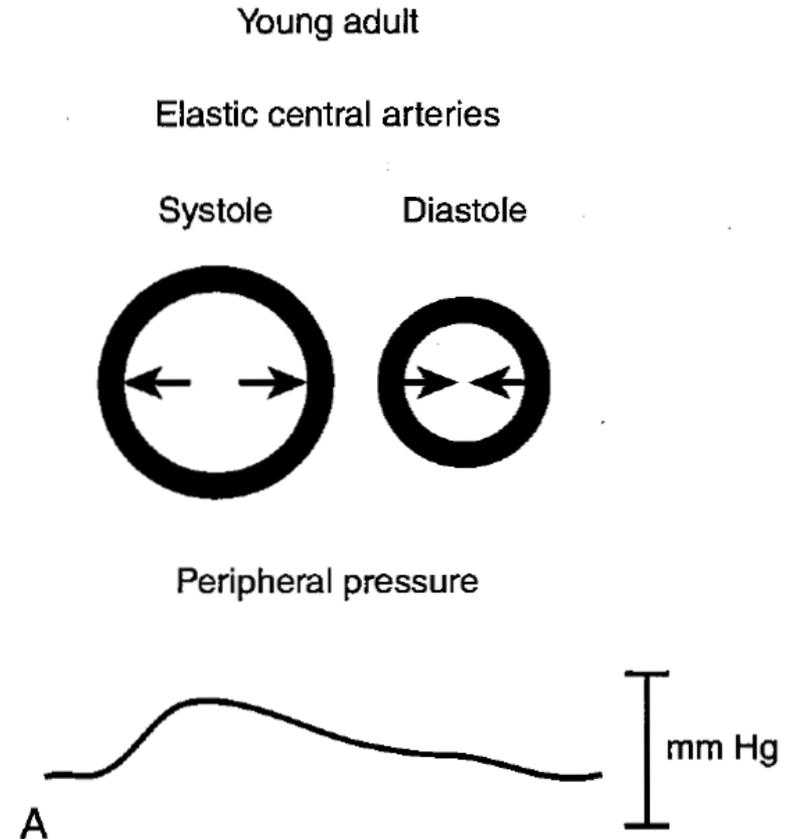
***Different impedance!***

# Vascular physiology

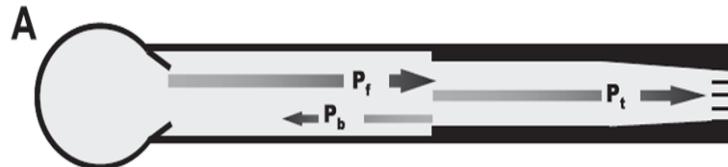
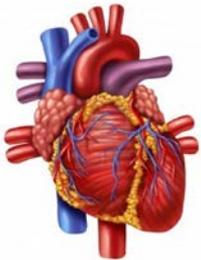
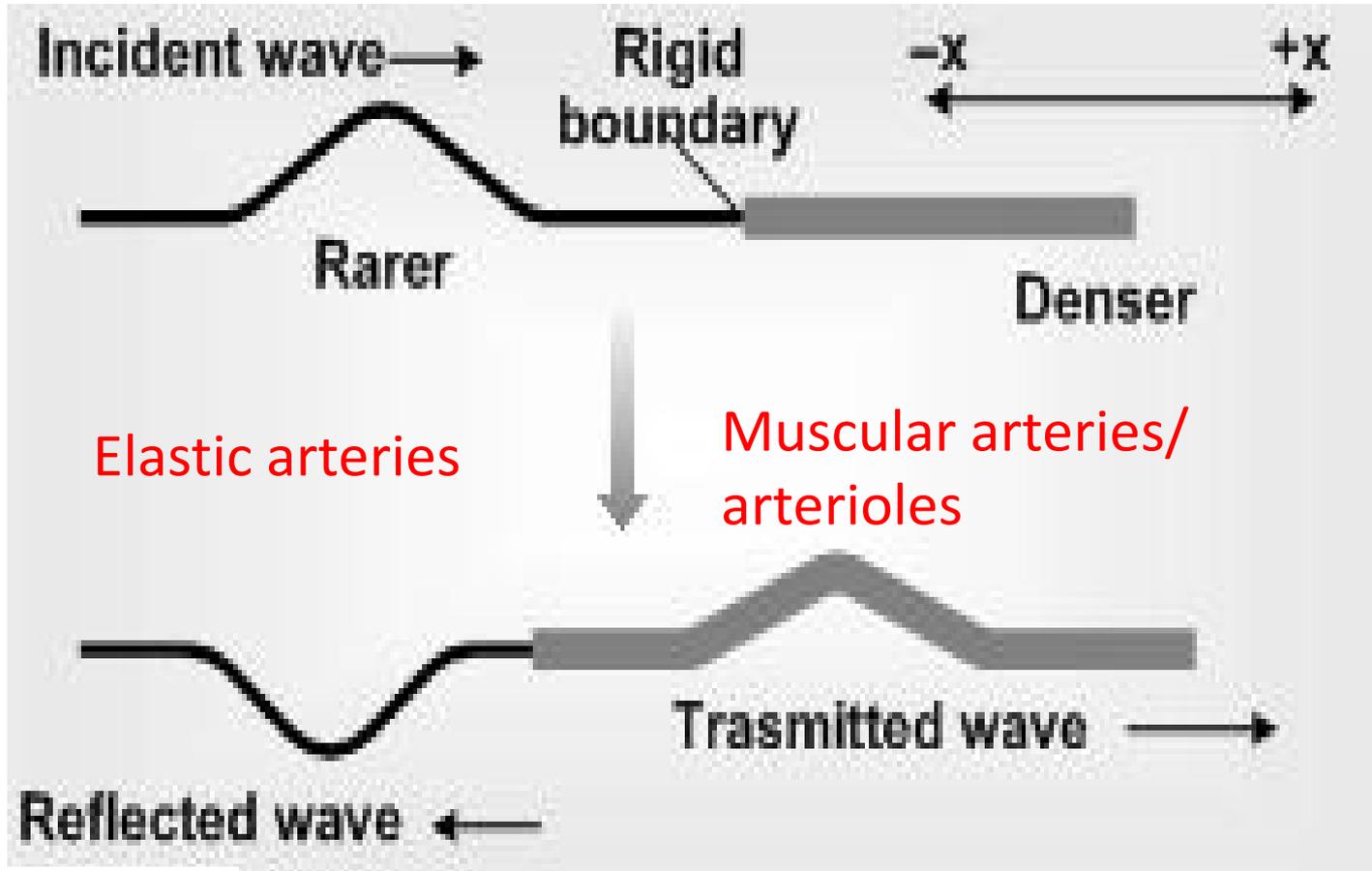
- Systole: ejection of blood
  - Elastic arteries expand to accommodate pressure, thus storing elastic energy



- Systolic blood pressure:
  - **120**/70

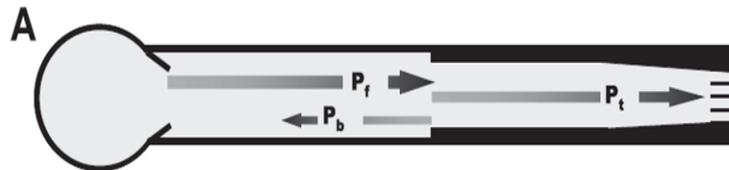


# When a wave hits a boundary...



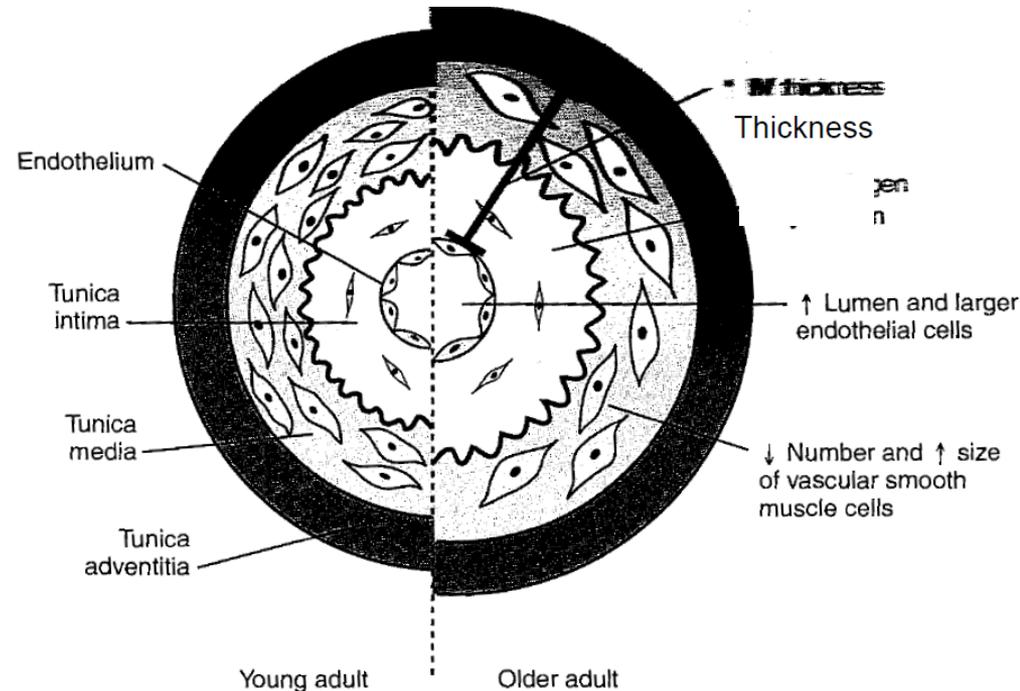
# Vascular physiology

- Partially reflected pressure wave goes back towards the heart
- Normally arrives just *after* diastole begins
- Diastole: aortic valve closes
  - Elastic arteries contract: release stored energy
    - Supports diastolic blood pressure: 120 / **70**
    - Also supplies coronary arteries and heart itself



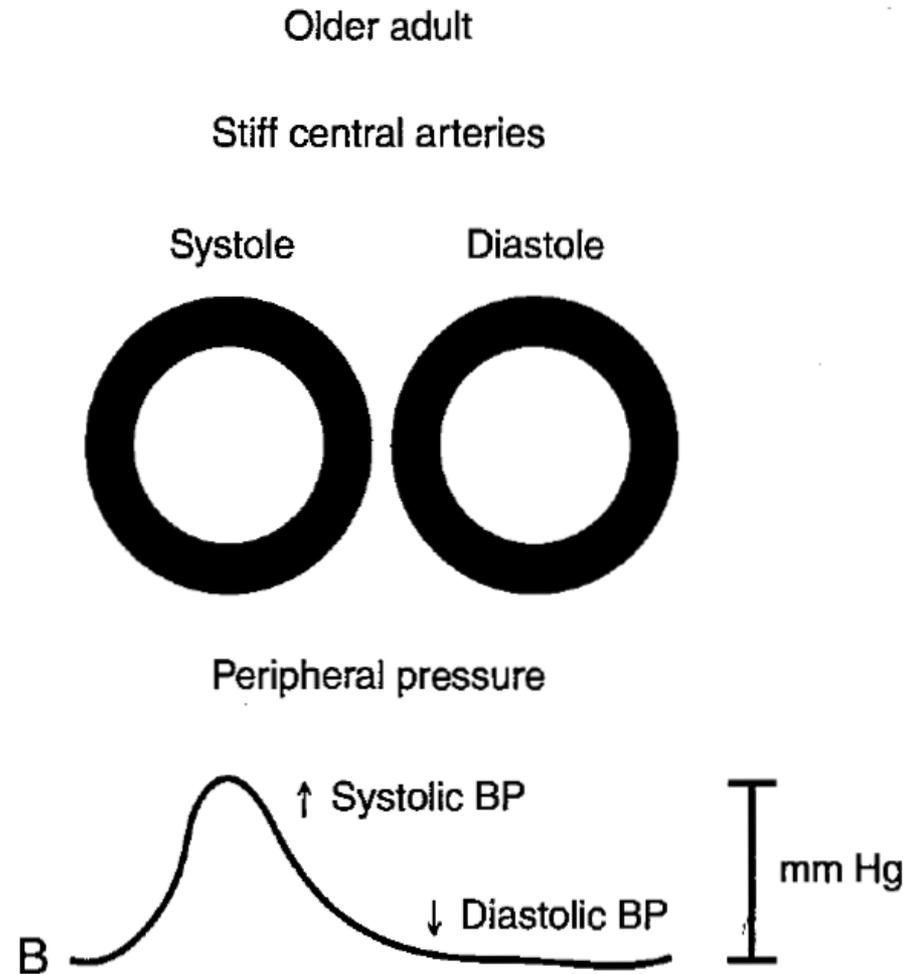
# Changes with age: from *distensible balloon* to *stiff garden hose*

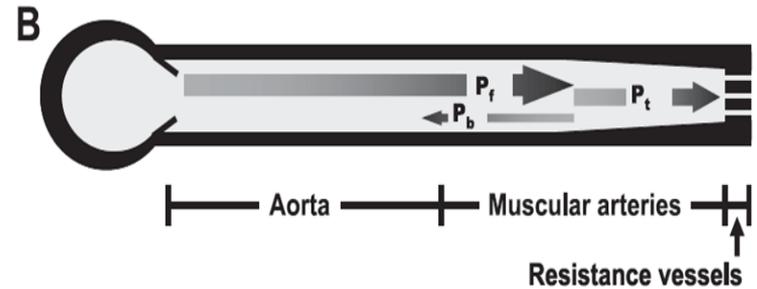
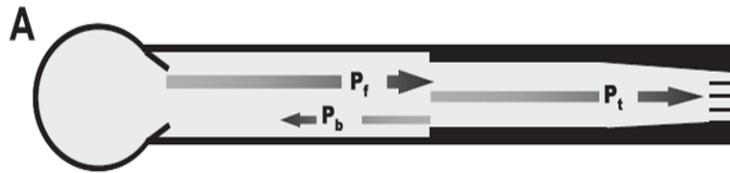
- Elastic arteries
  - Fractured elastin: *wear and tear*
  - Replaced by more collagen
  - Thickening of wall
    - Stiffer vessel
- Muscular arteries
  - Endothelial dysfunction
  - Increased muscular tone



# Abnormal physiology

- Systole: ejection of blood
  - Major arteries can't expand to accommodate pressure
  - Systolic blood pressure rises: 120/70 -> **170**/?





- Pressure wave travels faster towards muscular arteries
  - Less mismatched “stiffness”
    - Less pressure wave reflection
    - More pressure transmission: *to brain, kidneys*
  
- Partially reflect wave heads back
  - Arrives early while heart is still in systole
    - Heart has to work harder
    - Too early to supply coronary arteries: less blood for the heart itself
    - Too early to support diastole blood pressure which falls
    - 170/ 50

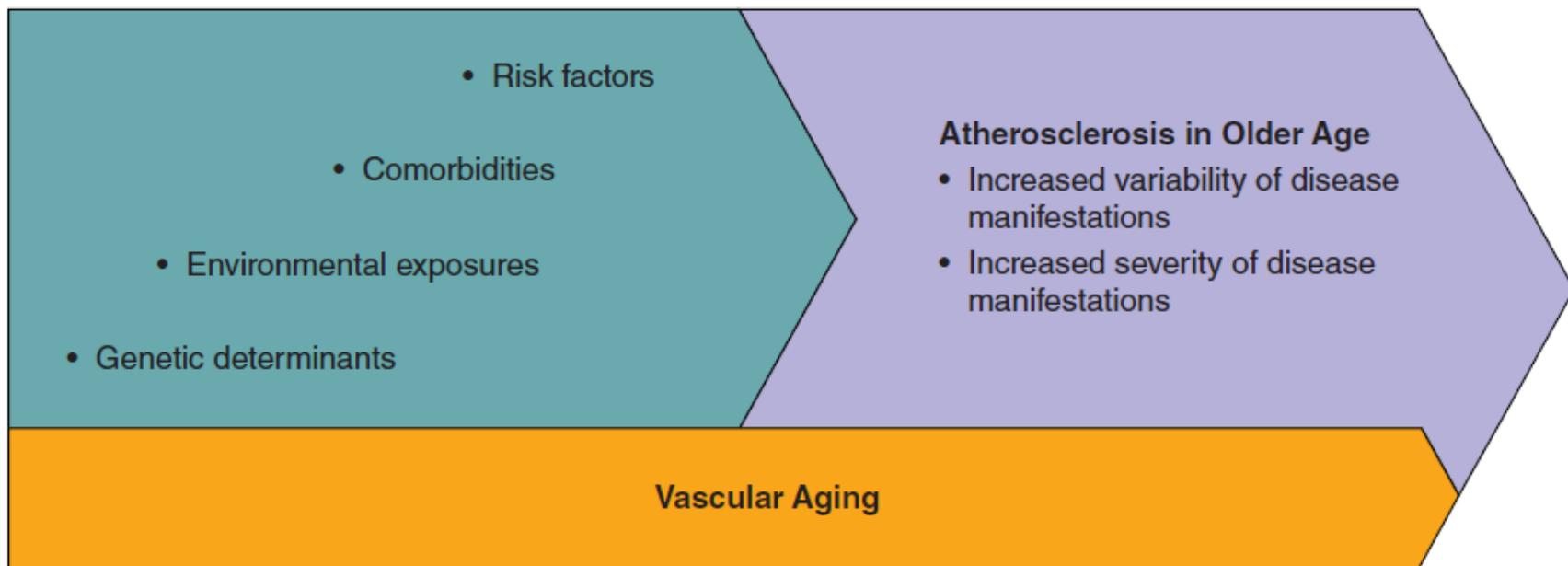
# Consequences of vascular aging

- Increased vascular resistance and higher blood pressure
  - Increased heart workload
  - Cardiac muscle enlargement “hypertrophy” and stiffness
  - Decreased blood supply: ischemia

- Hypertension:
  - Strokes
  - Dementia
  - Kidney failure



- Low diastolic blood pressure: falls, fainting, brain impact...



**FIGURE 76-3.** Contributors to the development of atherosclerosis interact with vascular aging to increase the variability and severity of disease manifestation in older age.

***Lack of physical activity is a major risk factor for vascular aging!***

From Heckman et al, Hazzard's Text., 2017

# In summary...

- Vascular aging leads to additional cardiac injury over time which increases risk for heart failure
- Contributes to general cardiovascular risk
- Leads to additional comorbidities
- ***But wait! There's more!***

# HF is a cardiogeriatric syndrome

Newman 2001; Rich 2001; Vogels 2007; Afilalo 2012; Harkness 2012

- Heart failure is associated with greater risk for
  - Frailty
  - Cognitive impairment
  - Atypical disease presentation
  - Functional decline
  - Incontinence
  - Polypharmacy
- Combination leads to more rapid decline, frequent decompensation, hospitalization, death

# Ontario Home Care clients with HF (2004-7): RAI HC outcomes

Foebel, Hirdes, Heckman et al, Age & Ageing 2011

<b>Variable</b>	<b>HF Sample N = 21,968</b>	<b>Non-HF Sample N = 154,898</b>	<b>P value</b>
<b>Mean Age (SD) years</b>	82.8 (7.2)	81.2 (7.3)	<0.001
<b>Gender (Female)</b>	58.8%	64.1%	<0.001
<b>Living Alone</b>	33.4%	35.4%	<0.001
<b>Cognitive Performance Scale &gt; 0</b>	53.8%	55.9%	<0.001
<b>Depression Rating Scale &gt; 0</b>	37.4%	37.4%	0.75
<b>ADL Hierarchy Scale &gt; 0</b>	44.2%	39%	<0.001
<b>Aggressive Behavior</b>	10.0%	12.7%	<0.001
<b>Comorbid Conditions</b>	4.0 (2.0)	3.3 (1.8)	<0.001
<b>Medication Count</b>	8.44 (4.0)	6.8 (3.9)	<0.001
<b>Home Care Service Use</b>			
• Homemaking	35.9%	31.4%	<0.001
• Nursing	33.9%	25.3%	<0.001
• Physical Therapy	11.1%	12.3%	<0.001

Schlegel • UWaterloo • Conestoga

# Disposition of HF Patients by Age Ontario, 2011

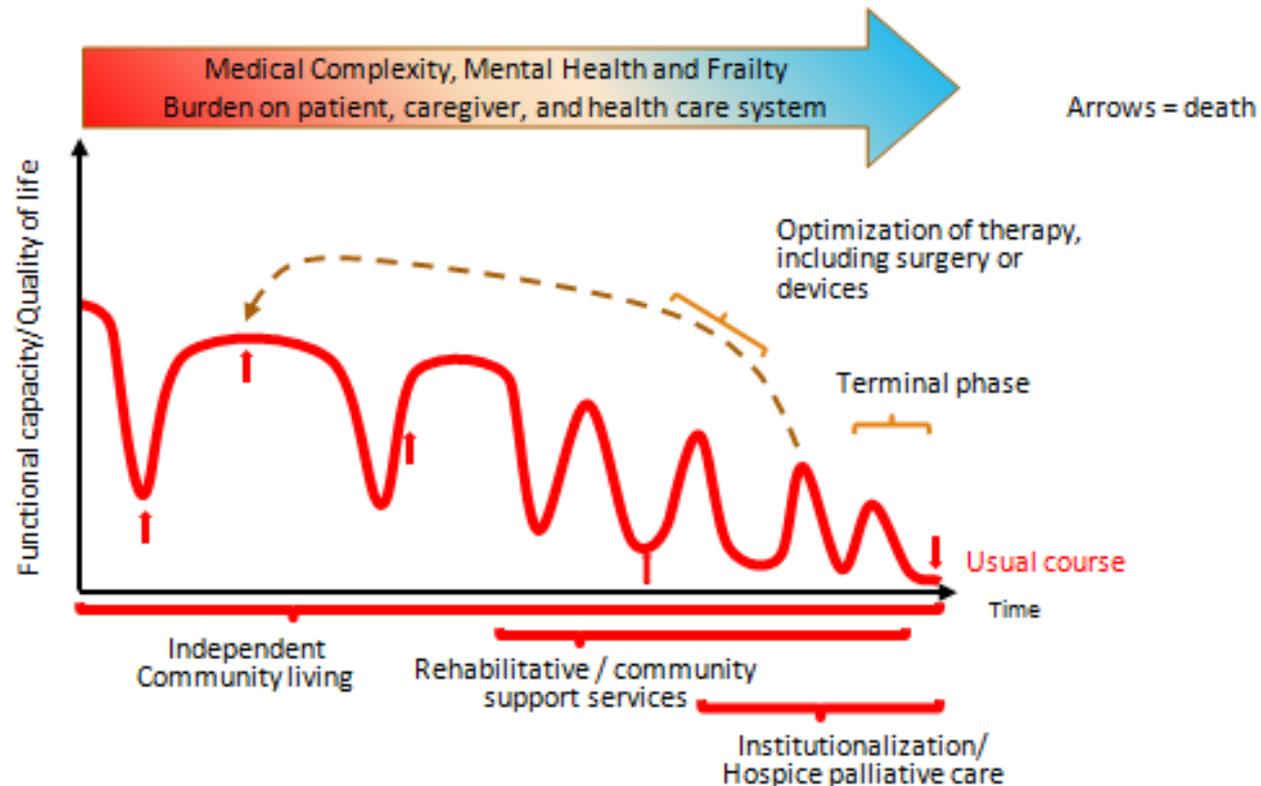
Age Group	Discharged Home		Transfers			Other		Grand Total
	No Support Services	<i>With Support Services</i>	Acute Inpatient Facility	<i>Continuing Care Facility</i>	Other Type of Facility	Left Against Medical Advice	Deceased	
<b>20-24</b>	0.1%	0.0%	0.3%	0.0%	0.0%	0.0%	0.1%	0.1%
<b>25-29</b>	0.2%	0.0%	0.3%	0.0%	0.0%	0.6%	0.1%	0.1%
<b>30-34</b>	0.4%	0.2%	0.3%	0.1%	0.0%	1.8%	0.1%	0.3%
<b>35-39</b>	0.6%	0.1%	0.7%	0.1%	0.0%	0.6%	0.1%	0.3%
<b>40-44</b>	1.0%	0.1%	1.5%	0.2%	0.0%	3.0%	0.0%	0.6%
<b>45-49</b>	1.6%	0.6%	3.2%	0.1%	1.1%	6.1%	0.3%	1.2%
<b>50-54</b>	3.2%	1.4%	3.0%	0.4%	6.4%	6.1%	0.3%	2.2%
<b>55-59</b>	5.2%	2.2%	6.2%	0.7%	3.2%	7.3%	1.3%	3.6%
<b>60-64</b>	8.2%	3.5%	10.8%	2.0%	9.6%	12.8%	2.4%	5.9%
<b>65-69</b>	10.7%	6.5%	13.4%	3.6%	8.5%	17.7%	4.3%	8.4%
<b>70-74</b>	13.9%	8.0%	15.0%	6.6%	5.3%	12.8%	7.3%	11.0%
<b>75-79</b>	15.8%	14.6%	16.7%	11.1%	12.8%	13.4%	13.5%	14.7%
<b>80-84</b>	18.3%	22.0%	14.8%	20.1%	21.3%	6.1%	22.4%	19.5%
<b>85-89</b>	14.3%	23.3%	10.9%	28.6%	21.3%	8.5%	26.2%	19.2%
<b>90+</b>	6.7%	17.6%	3.0%	26.4%	10.6%	3.0%	21.5%	13.0%
<b>Totals</b>	<b>50.1%</b>	<b>23.0%</b>	<b>3.6%</b>	<b>13.3%</b>	<b>0.5%</b>	<b>0.8%</b>	<b>8.8%</b>	<b>100.0%</b>

# Heart Failure: The BIG picture



## Patient centered outcomes

1. Optimal HF therapies through to advanced stages
2. Engagement of patients and caregivers in self-care
  - i. To monitor symptoms and weights for decompensation detection and timely intervention
  - ii. Define care goals
  - iii. Advance care planning



# Heart Failure in 2017: a perfect storm

- More persons affected
  - Better treatments (not cures) for CV disease
  - Vascular aging and its consequences
  - Population ageing
- Rising patient complexity
  - Geriatric syndromes
  - Comorbidities
  - Risk of recurrent episodes and progressive decline to death
- A complex, fragmented system designed for acute problems
  - Heavy multisector resource use
  - Multiple transitions

# Implications

O'Connor JACC: Heart Failure 2017; Beaulieu CMAJ 2013; Fenton 2006

- Health care systems with better HF outcomes have better outcomes overall
- Substantial evidence on how to manage heart failure
  - Inpatient care
  - Chronic disease management programs
  - Transitional care
  - Palliative care
- Increased primary care, long term care capacity:
  - Shared care models: specialists embedded in primary care
  - Interprofessional care
  - Adapt fee schedules
  - Clinician training implications
- Greater system integration is required

# Prevention

- Physical activity to prevent vascular aging: public health issue
- CLSA: opportunity to look at vascular aging
  - Consider adding measures of vascular stiffness



- Astronaut arteries age 10 to 30 years in space

# Conclusions

- Heart failure is an archetype
  - Common
  - Geriatric
  - Multimorbidity
  - High system impact
- Lots of evidence: we know what to do
- We just need to do it
- Fix heart failure, fix the health care system

# Upcoming CLSA Webinars

## Multimorbidity in Canada

Philip St. John, MD

Associate Professor, University of Manitoba  
Co-lead Manitoba site investigator, CLSA



May 24, 2017 | Noon ET

Register: [bit.ly/clsawebinars](http://bit.ly/clsawebinars)