

Using Actuarial Methods to Minimize Chronic Disease

2016 CAS Spring Meeting

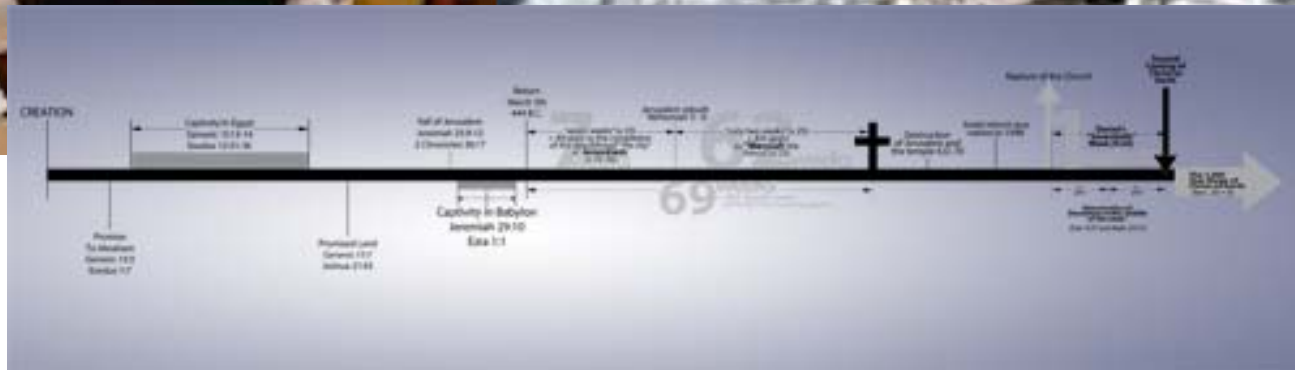
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The Goal

- Making the plethora of health data actionable so we reach the triple aim:
 - patients are healthier,
 - providers are happier, and
 - costs are lower

- While appreciating that...
 - Higher Risks and Costs are Concentrated in a small % of any Population

The Risks



‘Opinion is good, but evidence is better...’

Risk Mitigation Steps

- Create information from data by conducting:
 - Exploratory Analysis
 - Modeling – 2 examples:
 - Workers' Comp
 - Healthcare

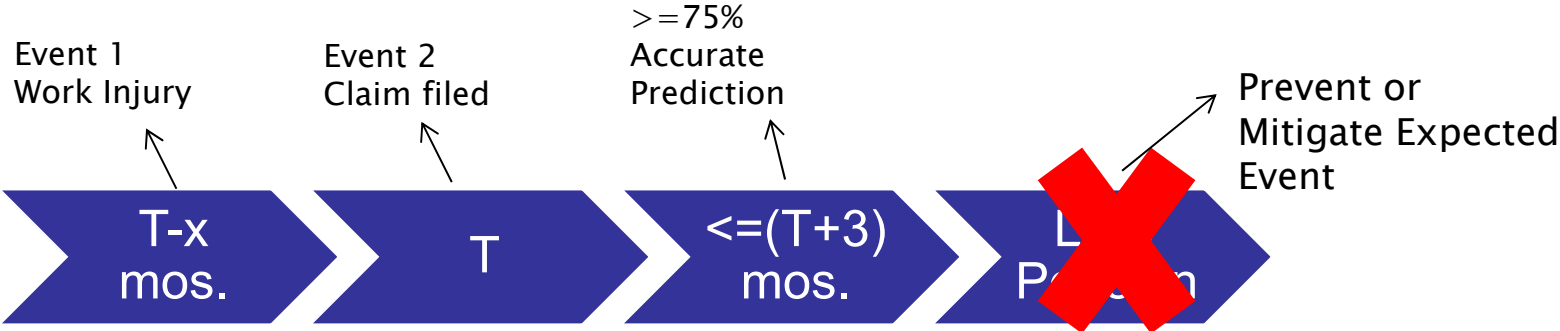
Exploratory Analysis

- Consider relative risk factors at as granular a level as possible to predict future expected events
- Step 1
 - Who? What common characteristics?
 - What are the implications of those characteristics?
- Step 2
 - *scarce resource allocation for maximum ROI*
 - Who is *intervenable* or *impactable*?

Example 1 - WorkSafe BC in 2000

- \$1 B public workers' compensation insurance
 - Non-profit/Universal-ish for BC workers
- In-house rehab
- Some analytics tools limitations
- New data warehouse
 - Traditional claims management model
 - Traditional data analysis

WCB Model Objective



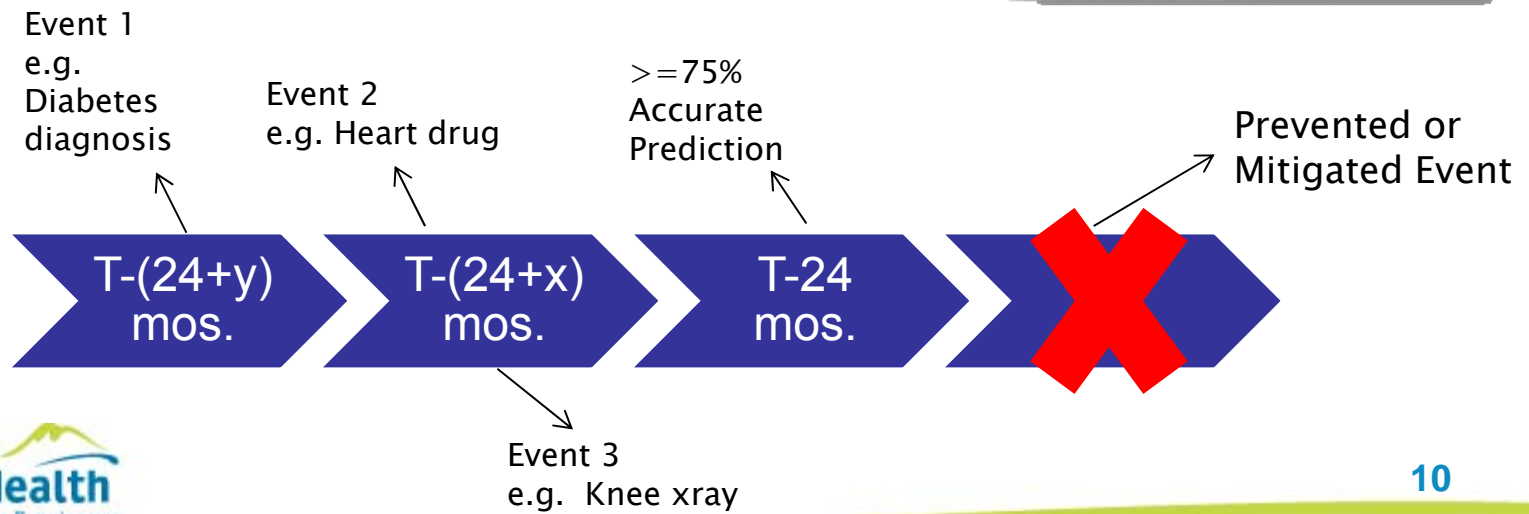
WCB Results

- **Published in Interfaces: Early Detection of High-Risk Claims at the Workers' Compensation Board of British Columbia**
- Decision-analysis and logistic-regression approach
 - decision analysis used to develop a classification rule with high out-of-sample predictive power
 - logistic regression models for injury type/age strata/workdays
- Implemented in a claims-profiling scorecard, which identifies claims needing early intervention in the claims management system
- High-risk claims are extremely costly
- The model saves about \$5 M annually

Example 2 - BC Ministry of Health 2010

- \$16 B Public health insurer
 - Non-profit/Universal-ish
- Data rich - many decades on almost all citizens (approx. 18 M lives)
- Analysis skill-sets
- Traditional BI tools

BC MOH Model Objective



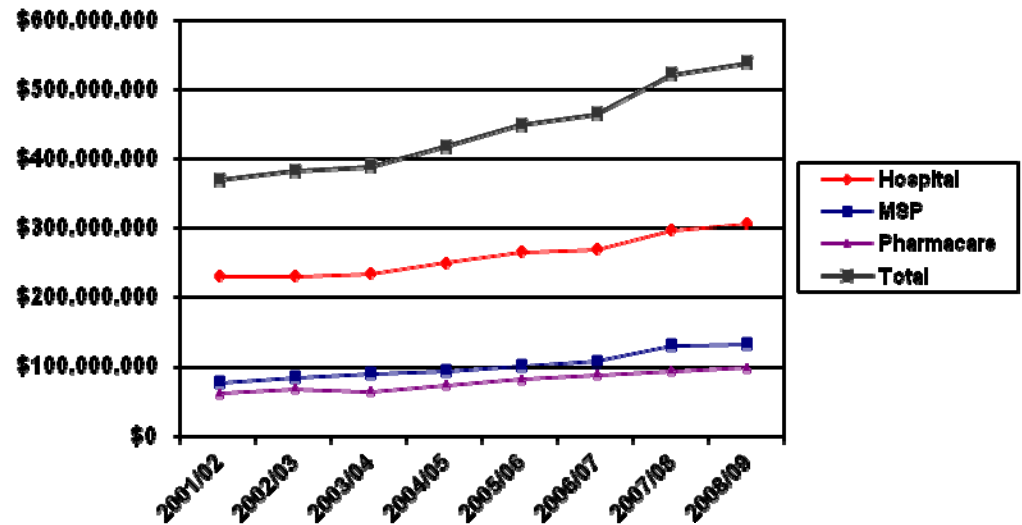
What is Heart Failure ?

- the **inability of the heart to pump blood** to meet the oxygenation and nutritional needs of the tissues, with multiple systems affected and participating in the dysfunction - more than just a weak pump
- can result from any structural or functional cardiac disorder that impairs the ability of the ventricle(s) to fill with or eject blood and can occur suddenly or slowly over a period of time
- can reduce the quality and length of life and can lead to frequent hospitalizations
- affects men and women equally. **Women** tend to be **older** with a history of **hypertension** (HTN) when first diagnosed; **men** tend to be younger at onset and have a history of **coronary artery disease (CAD)**
- Common with age, so incidence and prevalence is expected to increase
- annual mortality anywhere from 5% to 50%, depending on the severity of the dysfunction and associated symptoms (ie. pulmonary edema) along with other factors (ie.co-morbidities)
- is a syndrome - a group of symptoms that collectively indicate or characterize a disease or other abnormal condition
- associated with numerous symptoms and causes so many ways a person may present. It continues to be a syndrome that is **difficult to diagnosis and treat effectively**

Not Fun...

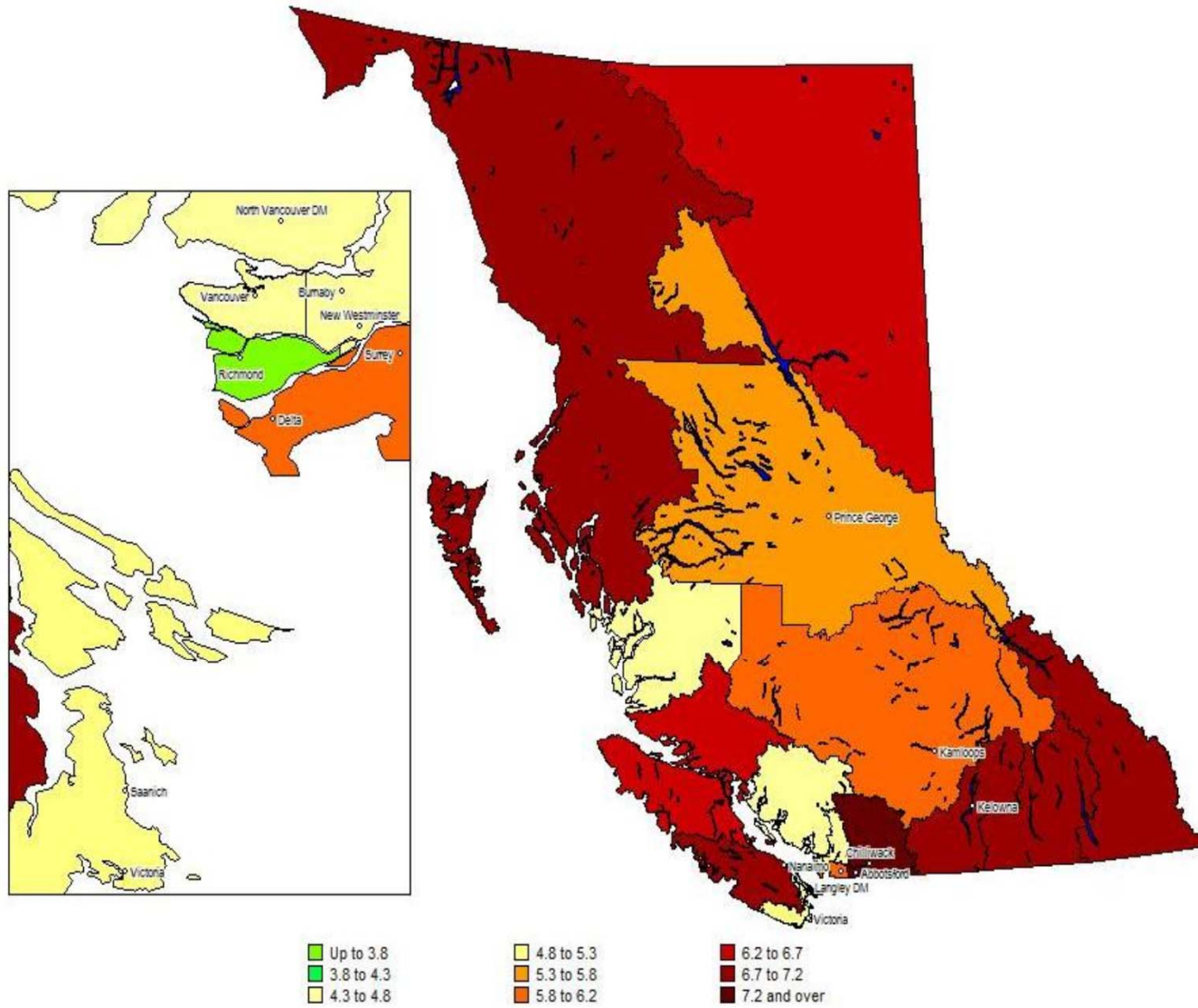
BC Heart Failure Statistics

- About 90,000 HF patients in BC in 2009/10 that cost \$600 M/year
 - Hospital ~\$340 M
 - MSP ~\$150 M
 - Pharmacare ~\$102 M

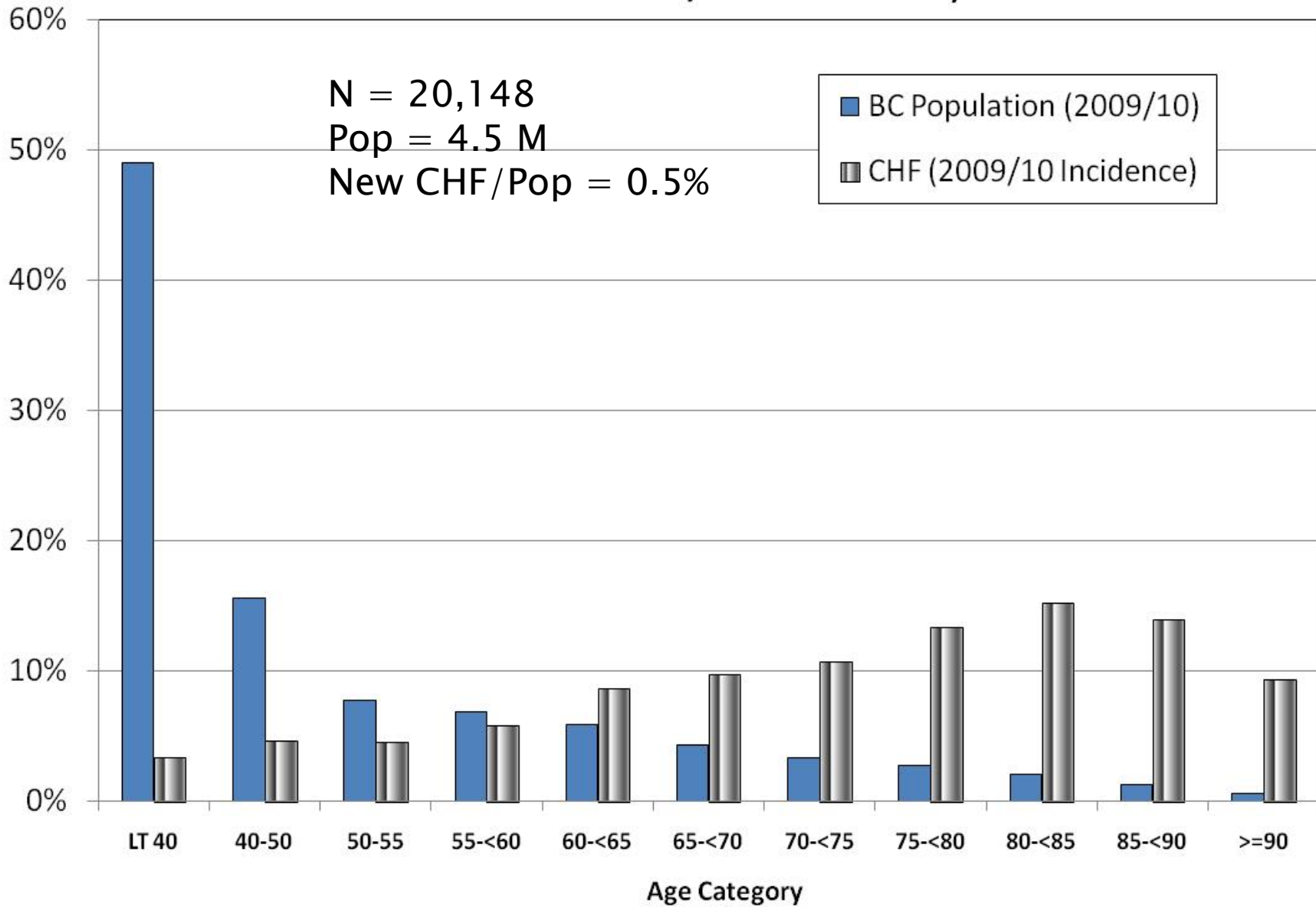


- HF is the **most common** cause of hospitalization of people > 65 years of age
- Average 1 year **mortality rate of 33%**, 4 year = 40%, 5 year = 50%
- Improved management can avoid 50% of inpatient HF related admissions

2010/11 HF incidence rate per 1,000 BC population aged 45 to 89 ()

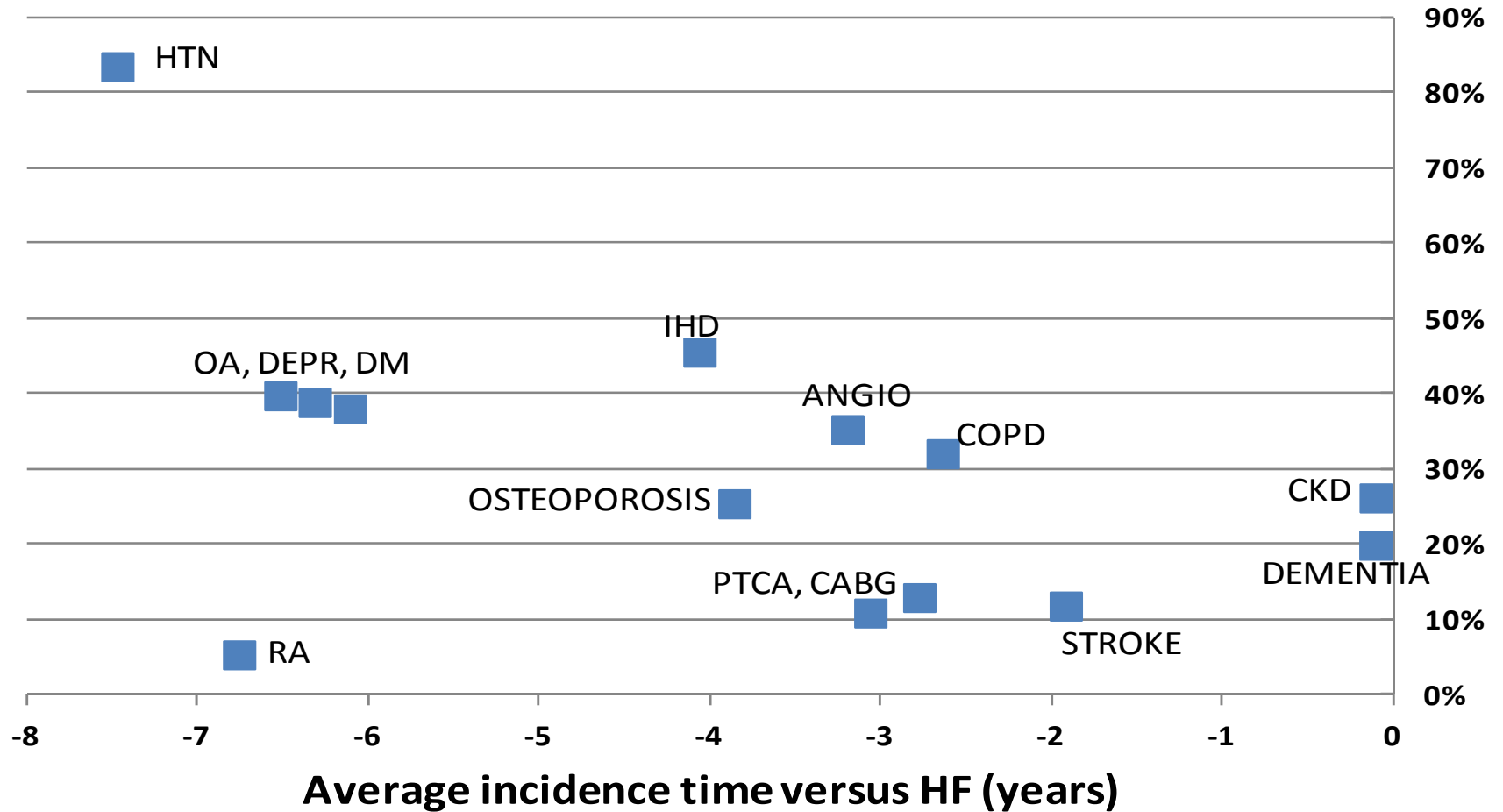


Comparison of 2009/2010 BC Population and CHF Patients (with Incidence Date in 2009/2010 Fiscal Year)



Pre-HF Chronic Conditions of the 09/10 HF Incident Cohort – one layer

% of HF patients with another select Chronic Disease



Preliminary Findings – No Surprises

- Membership in chronic disease registries and lab tests are important
- Of approx. 800 initial variables, about 15 remain (depending on strata)
- Decision trees and path analysis found 100 significant variables from the 800

- Of the General Linear Models, **discriminant analysis** did the best - it achieved a classification rate of about **70%** for age groups of interest
- **Neural network** modeling was next at about **65-71%** classification rate
- **Logistic regression** resulted in a **60-65%** classification rate

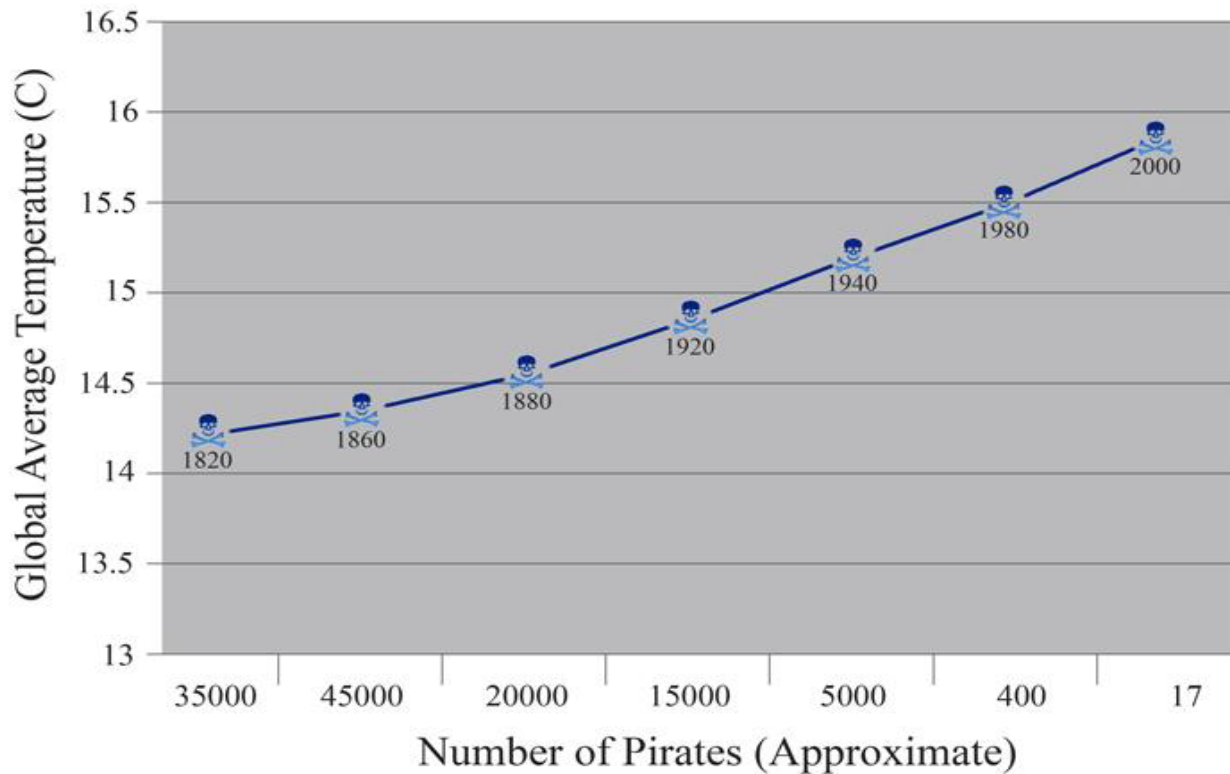
- **Survival analysis achieves the best result**
 - From *NINE* years pre-incidence, it finds about **85%** of 45+ year-old who became HF incident

Modeling is not...



It's the data and the methods, BUT...

Global Average Temperature Vs. Number of Pirates



www.venganza.org

- The # of pirates has decreased since 1860

- The globe has been warming

- Thus, Somalia is saving the planet

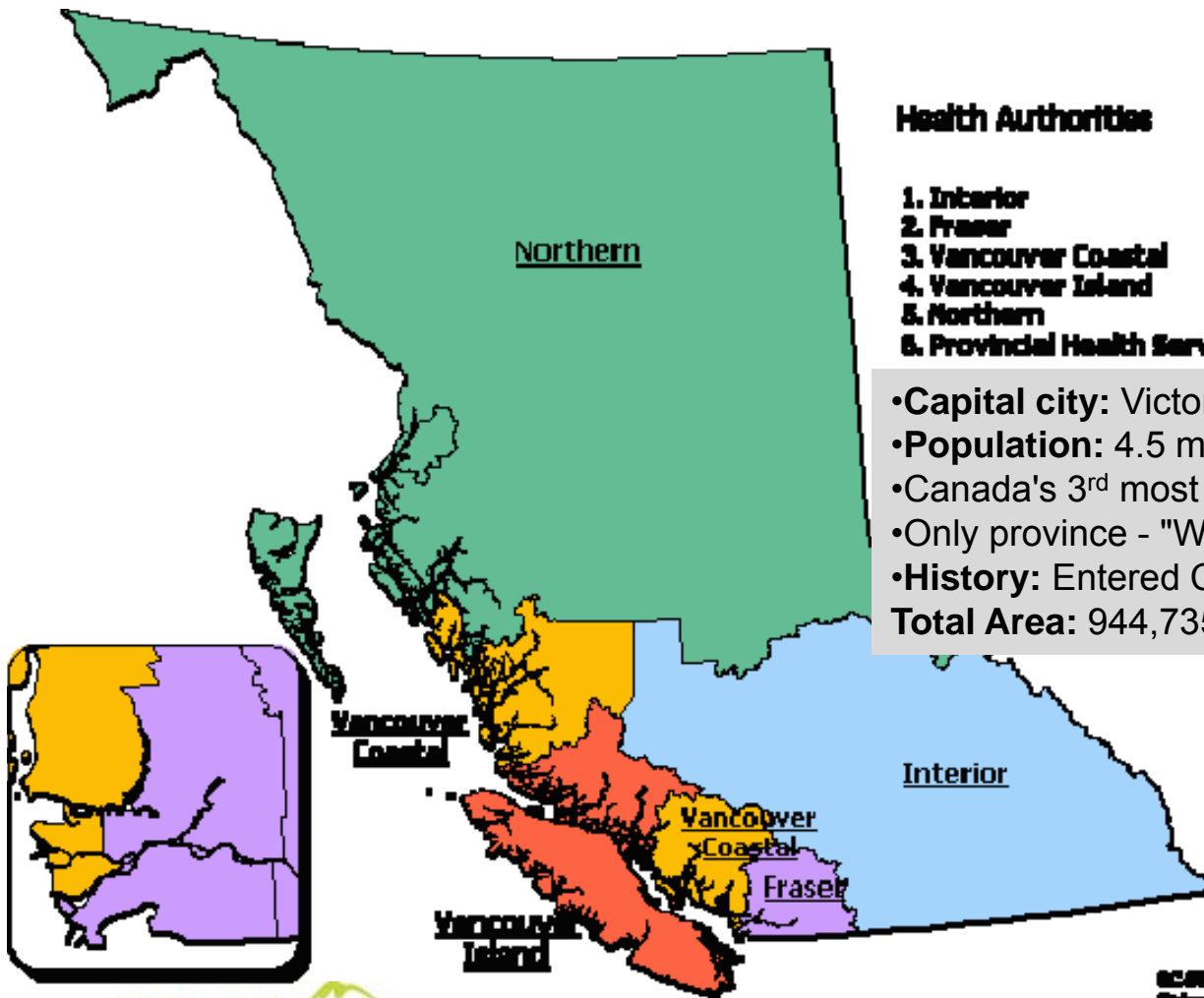
- Really ???

It's Really the Skillset

- Truly 'listen' to the data, which is at the heart of the actuarial approach
 - Abandon pre-conceived notions of relationships
 - Abandon traditional data stratification practices
- per Lisi (2011):

“Humans are terrible at dealing with probability. We are not merely bad at it, but seem hardwired to be incompetent, in spite of the fact that we encounter innumerable circumstances every day which depend on accurate probabilistic calculations for our wellbeing... This blind spot in our collective consciousness – the inability to deal with probability – may seem insignificant, but it has dire practical consequences.”

BC Health Geography



Health Authorities

1. Interior
2. Fraser
3. Vancouver Coastal
4. Vancouver Island
5. Northern
6. Provincial Health Service

- Capital city: Victoria on Vancouver Island
 - Population: 4.5 million (Vancouver - 2.3M, Victoria – 370k)
 - Canada's 3rd most populated province (after Ontario/Quebec)
 - Only province - "West Coast special" – ski/golf on same day
 - History: Entered Canadian confederation in 1871
- Total Area: 944,735km²/364,764mi² – double Texas

VCH - Who we serve

- **25% of BC's population (> 1 M)**
- **22,000 staff, 2,500 physicians and 5,000 volunteers**
- **556 locations including;**
 - 13 hospitals
 - 3 diagnostic/treatment centres
 - 15 community health centres
- **46% of all inpatient specialized care in BC**
- **58,560 km² (22,610 mi²) including;**
 - 12 municipalities, 4 regional districts and 14 Aboriginal communities
- **We operate:**
 - 8,936 acute, rehabilitation and residential beds
 - 421 community residential care beds
 - 621 assisted living beds/units
 - 1,430 mental health supported housing units
 - 2,447 mental health beds
 - 1,312 addictions beds

Next Steps

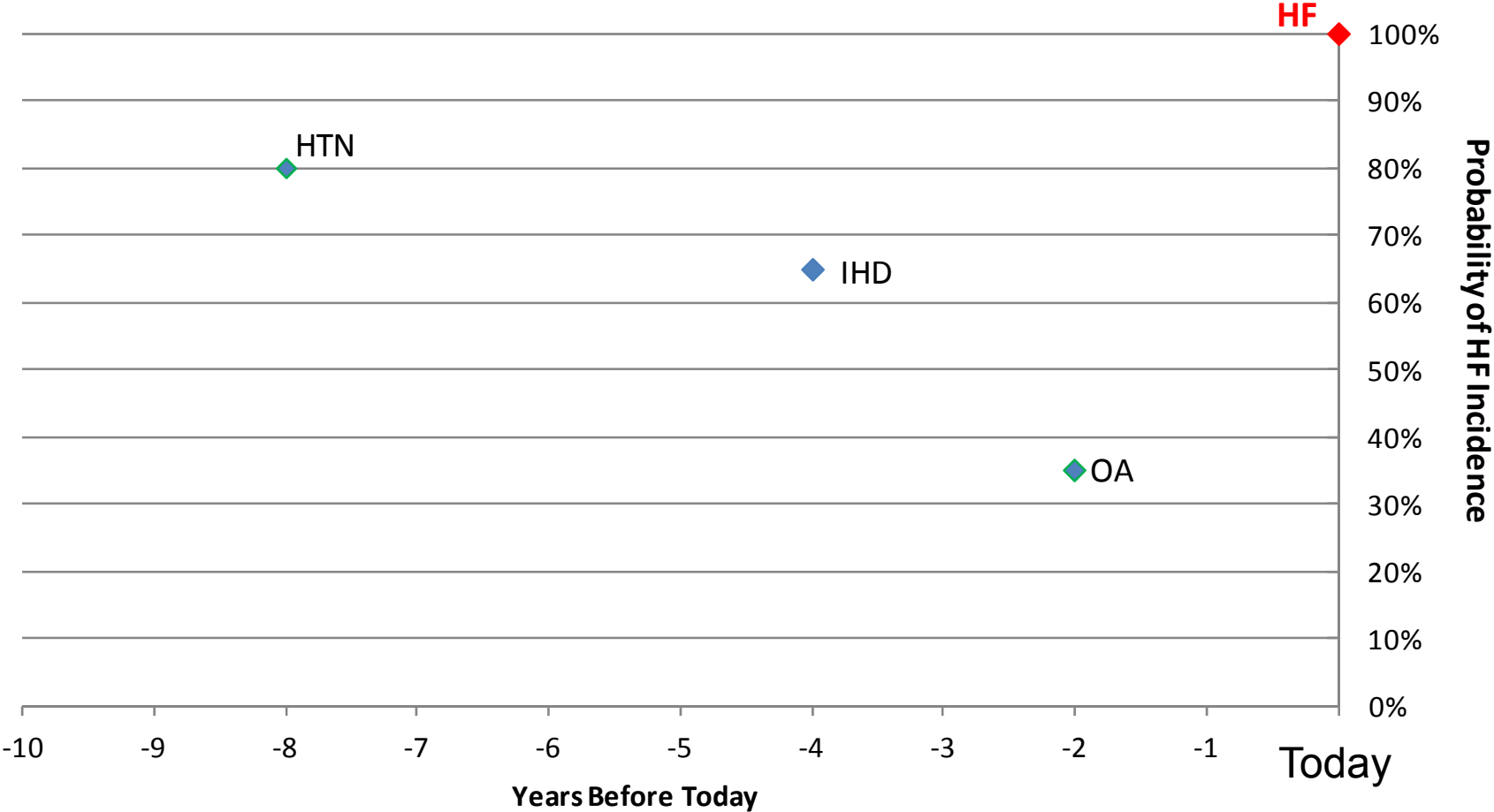
- Create a dynamic modeling process
- Identify VCH citizens at high risk of HF incidence and communicate them with providers
- Work with Primary Care/GPSC/BC HF SC to provide evidence-based care for those identified

What do we hope to achieve?

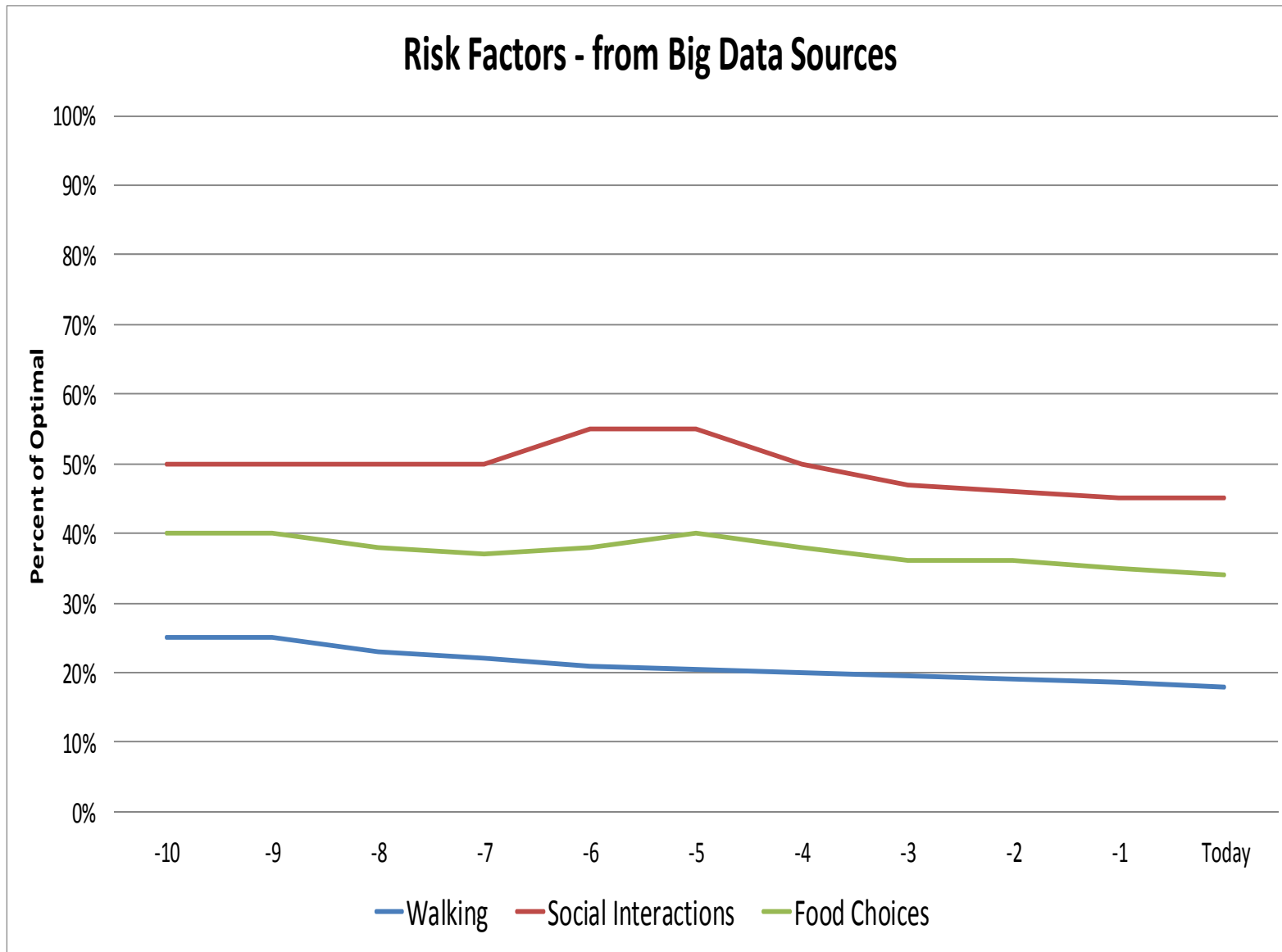
- To promote *proactive monitoring for* HF in the community with a case finding approach and registry
- To improve the *care pathway* of high-risk patients for HF through the GPs office
- Develop relationships and *shared care plans* amongst family physicians, patients, specialists and acute care / community services
- To promote and encourage *optimal management* of HF according to national guidelines

Enabling Actionable Conversations with Impactable Patients

Patients X's Experience to Date

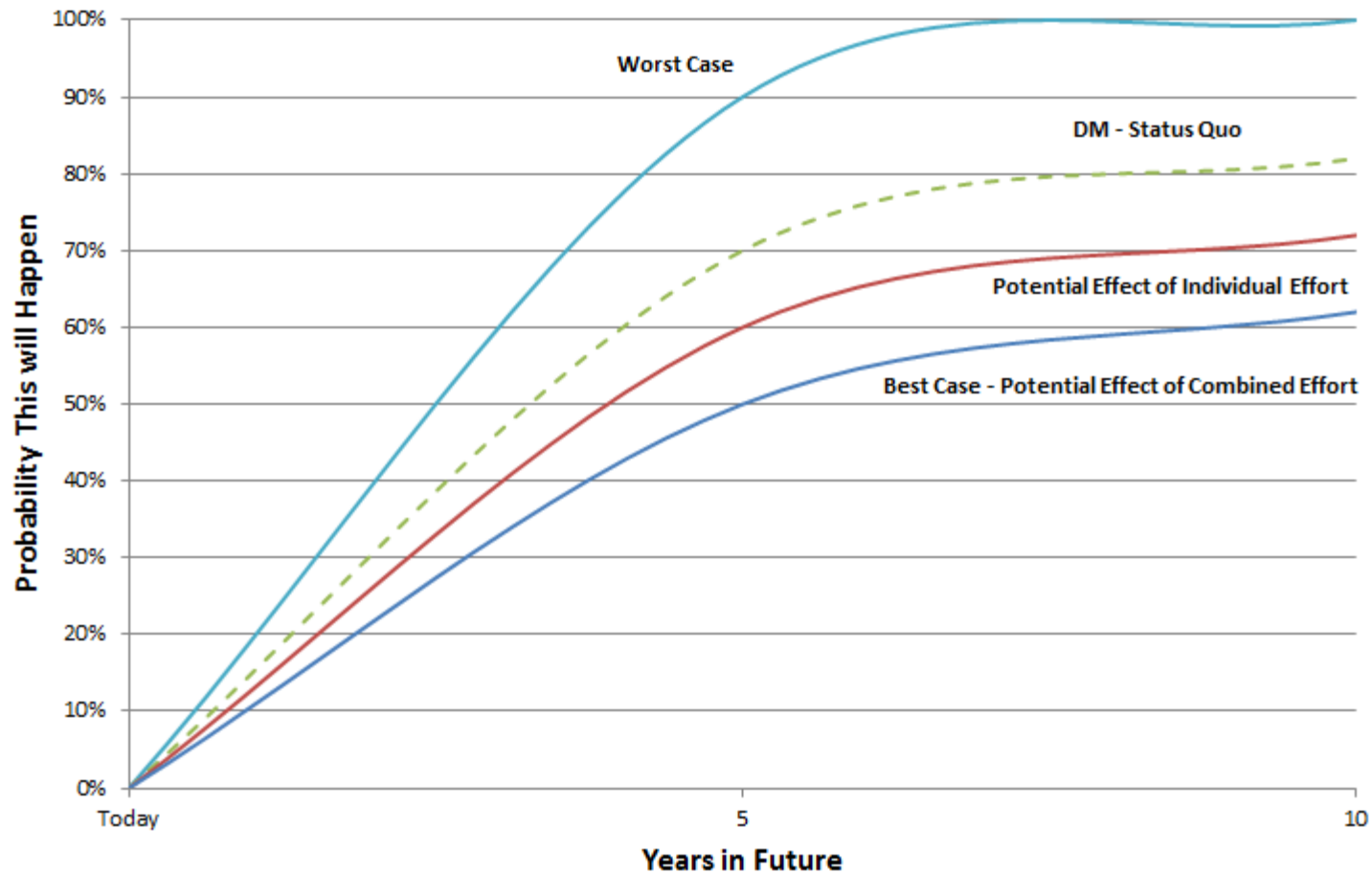


Beyond the Horizon



Enabling Actionable Conversations with Impactable Patients

Patient X's Expected Future - Re Diabetes for example



10

Possible Clinical Next Steps

The Healthy Living Partnerships to Prevent Diabetes Study: 2-Year Outcomes of a Randomized Controlled Trial

[Jeffrey A. Katula](#), PhD, MA et. Al. NC

American Journal of Preventive Medicine, [Volume 44, Issue 4, Supplement 4](#), p. S324-S332, April 2013

Results

Intent-to-treat analyses of between-group differences in the average of 18- and 24-month measures of outcomes (controlling for baseline values) revealed that the LWL participants experienced greater decreases in fasting glucose (-4.35 mg/dL); insulin (-3.01 μ U/ml); insulin resistance (-0.97); body weight (-4.19 kg); waist circumference (-3.23 cm); and BMI (-1.40), all p -values <0.01.

Conclusions

A diabetes prevention program administered through an existing community-based system and delivered by community health workers is effective at inducing significant long-term reductions in metabolic indicators and adiposity.

Physician Profile Report

Family doctor central to chronic care, Manitoba study says

Most chronic care patients in Manitoba receive care from their regular family doctors, a study this week from the Manitoba Centre for Health Policy (MCHP) says. Four of every five visits for care are provided by the regular doctor,

however many referrals to specialists are not made by a person's main family doctor, but by another family doctor.

Dr. Alan Katz, lead author of the study, says further study is needed to explain patterns of care provided by non-assigned primary care doctors.

"This is at odds with medical evidence that an ongoing doctor-patient relationship is best for health outcomes."

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Q & A

Thanks for your feedback!