

# Using Predictive Modeling to Mitigate Risk in Health Care

Session X

December 5, 2013

Predictive Modeling Summit

Care Continuum and Actuarial Analytics, VCH and  
Modeling and Analysis, BC MOH

# PM in Healthcare

- **Predictors of congestive heart failure in the elderly: the Cardiovascular Health Study**

Gottdiener et. al. *J Am Coll Cardiol.* 2000;35:1628 –1637

- **Predictors of heart failure among women with coronary disease**

Bibbins-Domingo et. al.. *Circulation.* 2004;110:1424 –1430

- **Risk factors for congestive heart failure in US men and women: NHANES I epidemiologic follow-up study**

He et. al. *Arch Intern Med.* 2001;161:996 –1002

- **Incident heart failure prediction in the elderly: the health ABC heart failure score**

Butler et. Al. Health ABC Study. *Circ Heart Fail.* 2008;1:125–133

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Etc Etc....

HENNESSY. Health Analysis Division, Statistics Canada NOV. 2010

# WorkSafe BC (nee WCB )12 Years Ago...

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    - Univer
  - In-hous
  - New da
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- Recent Accidents**
- Bones broken, back injured when forestry worker fell 35 feet
  - Worker burned while opening access hatch
  - more incidents
- Fatalities**
- Truck drivers died when their vehicles collided head-on and burned
  - Worker crushed between cab and boom of excavator
- Note: as of Feb 18, 2013

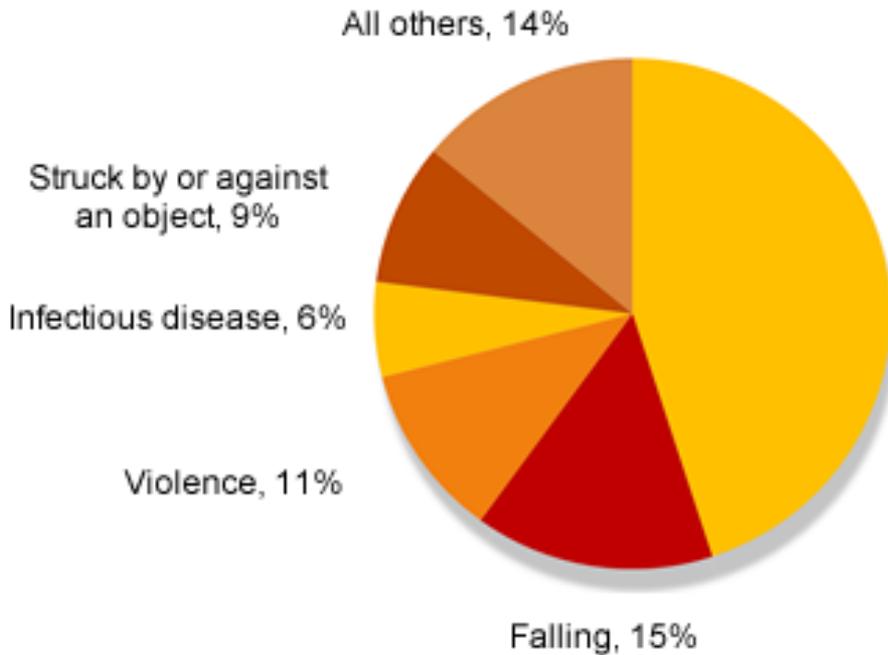
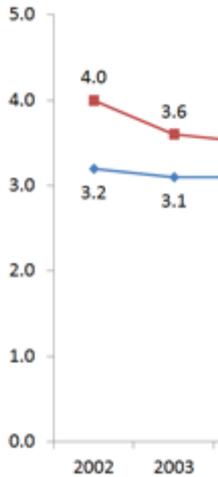
# Current BC WC Stats - Healthcare

Health Care & Social Assistance

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Claims by Accident Type (Five Year Average) 2007-2011

Health Care & Social Assistance (subsector 7660)



## n Healthcare

e Care

;Term Care

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where specified)

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# WCB Objective



Event 1  
Work Injury

Event 2  
Claim filed

$\geq 65\%$   
Accurate  
Prediction



# 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
- High-risk claims are extremely costly to the WCB;
  - For 321,000 short-term disability claims between 1989 and 1992, high-risk claims accounted for:
    - \$1.2 billion (64%) of the total payment of \$1.8 billion,
    - 4.2 % of the claims.
- logistic regression models for injury type/age strata/workdays
- decision analysis used to develop a classification rule with high out-of-sample predictive power
- WCB incorporated these results in a claims-profiling scorecard, which identifies claims needing early intervention
- The model saves the WCB about \$4.7 million annually

# BC Ministry of Health

- \$16 B. Public health insurer
  - Non-profit
  - universal
- Massive amounts of data over many decades on almost all citizens (18 m. lives)
- Analysis skill-sets
- BI tools being upgraded

# MOH Objective



Event 1  
e.g.  
Diabetes  
diagnosis

Event 2  
e.g. Heart drug

$\geq 75\%$   
Accurate  
Prediction



Event 3  
e.g. Knee xray

Prevented or  
Mitigated Event

# 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 both 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)**
- more common as a person ages, and as live longer, the incidence and the prevalence of HF in the population is expected to increase
- has an 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.'
- HF is associated with numerous symptoms and causes and subsequently there are many ways a person may present. It continues to be a syndrome that is **difficult to diagnosis** and to treat effectively.

# Analysis / Modeling

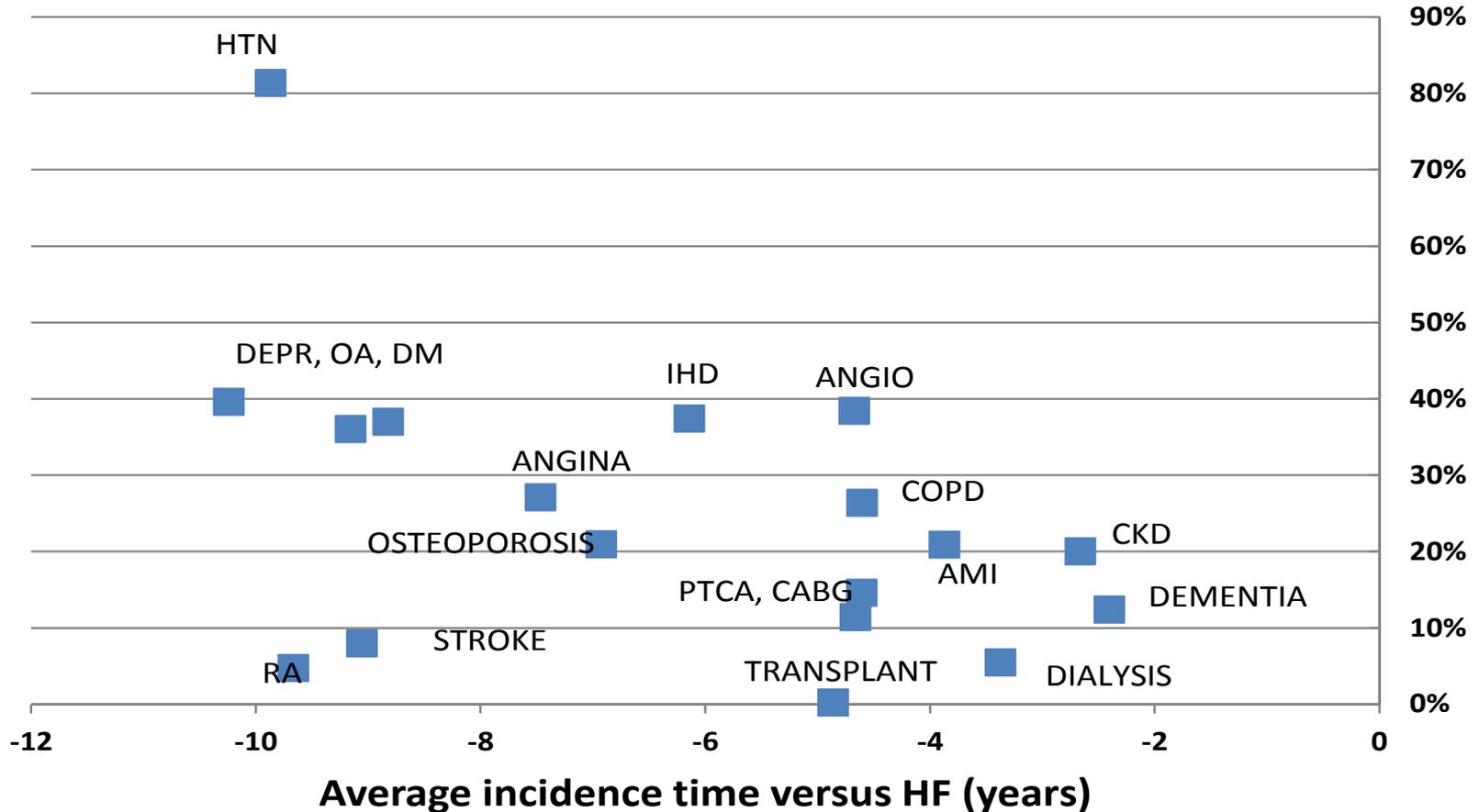


# Exploratory Analysis

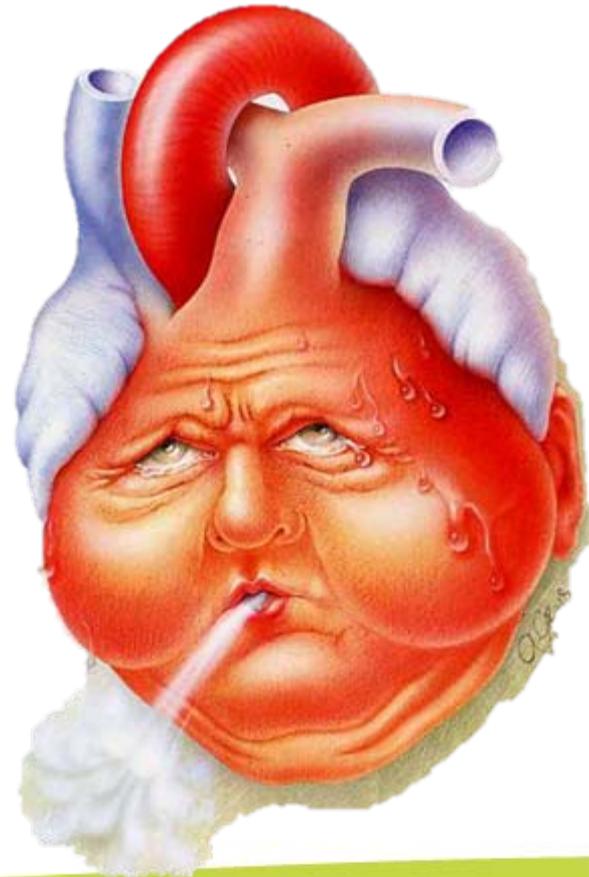
- ▶ considers relative risk factors to predict future expected events
- ▶ Step 1
  - Who? What common characteristics?
  - What are the implications of those characteristics?
- ▶ Step 2
  - *scarce resource allocation for maximum ROI*
  - Who is *intervenable or impactable*?

# Pre-HF Chronic Conditions of the 10/11 HF Incident Cohort

## Proportion of 2010/11 HF incident patients with Prior select Chronic Diseases



# How good are the various models at figuring out if your patient is at high risk for heart failure?



# Preliminary Findings

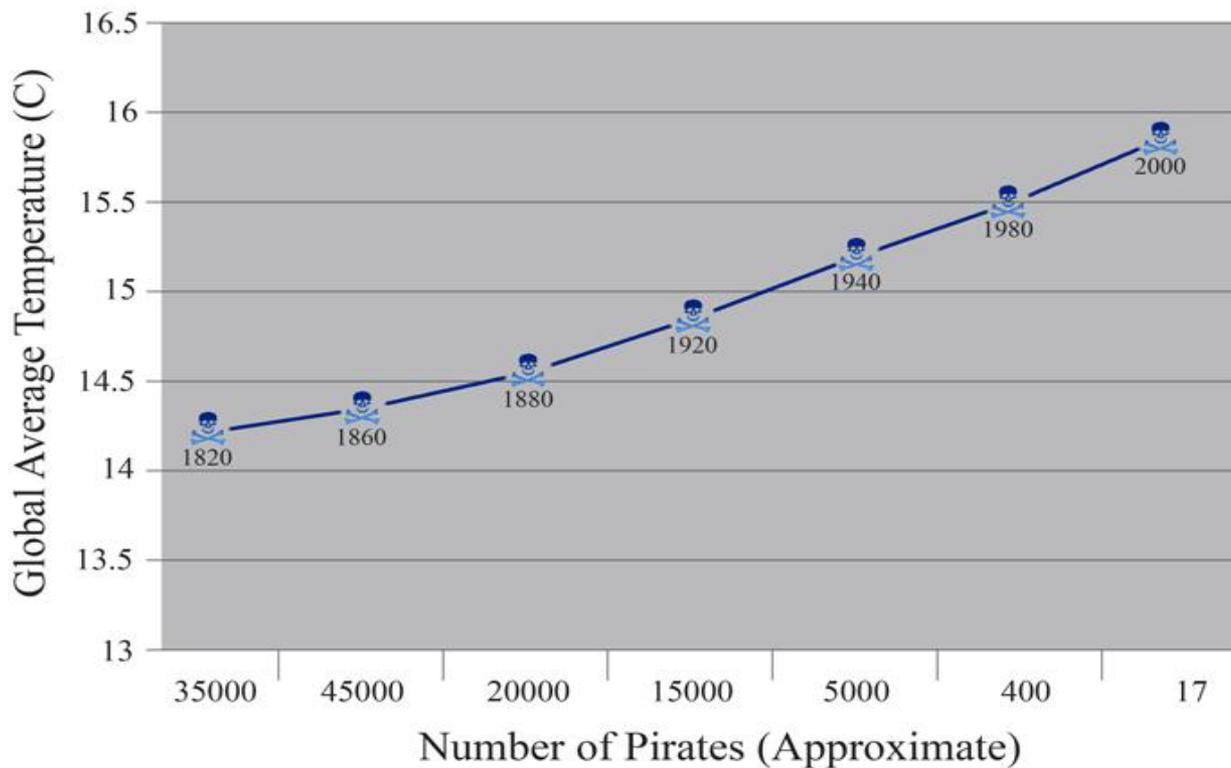
- Membership in chronic disease registries is important
- Various modeling techniques were explored, most of which achieved classification rates of 60-70%
- The actuarial-based models achieved classification rates which far exceeded the goal

# 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 ???

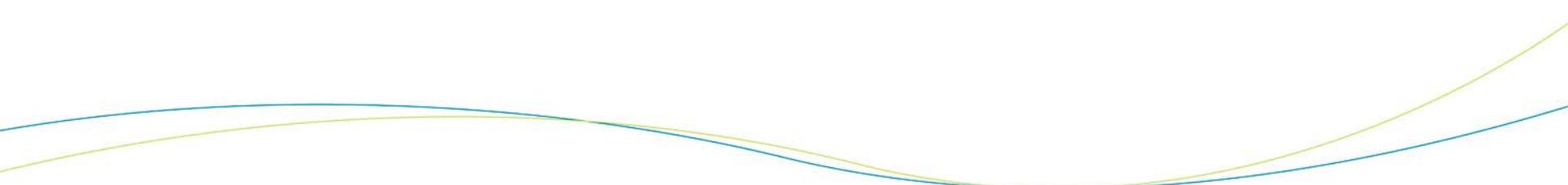
# It's Really the Skillset

- Know how to 'listen' to the data
- 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.”

# Next Steps

- Conduct an external validation study at VCH with the MOH model results
- Work with Primary Care/GPSC/BC HF SC to provide evidence-based care for those identified
- Trial risk reduction strategies with those identified as being at risk of HF incidence



# Q & A

Thanks for your feedback!