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
- Predictors of heart failure among women with coronary disease
- 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
- Etc Etc....

Hennessy. Health Analysis Division, Statistics Canada Nov. 2010
WorkSafe BC (nee WCB) 12 Years Ago...

- $1 B public workers’ compensation
  - Non-profit
  - Universal for BC workers/employers
- In-house rehab
- New data warehouse

Traditional claims management model
Traditional data analysis

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

Claims by Accident Type (Five Year Average) 2007-2011
Health Care & Social Assistance (subsector 7660)

- Overexertion, 45%
- Falling, 15%
- Violence, 11%
- Infectious disease, 6%
- Struck by or against an object, 9%
- All others, 14%

- Claims in Healthcare
- Term Care
- Community Health Support Services
- Ambulance or First Aid Services
- Essential Social Service Facility
- Retirement Home or Seniors' Home (accommodation only)
- Religious Organization
- Medical Clinic or Medical Practice (not elsewhere specified)
- Physiotherapy or Occupational Therapy

BC
WC
2012
Claim Costs Paid ($19 m)
in Healthcare
Acute Care
Long Term Care
Community Health Support Services (not elsewhere specified)
Ambulance or First Aid Services
Essential Social Service Facility
Retirement Home or Seniors' Home (accommodation only)
Religious Organization
Medical Clinic or Medical Practice (not elsewhere specified)
Physiotherapy or Occupational Therapy
WCB Objective

Event 1  
Work Injury

Event 2  
Claim filed

$\geq 65\%$  
Accurate Prediction

$T-x$ mos.  
|  
|  
$T$  
|  
$\leq (T+3)$ mos.  
|  
$\times$  
|  
Prevent or Mitigate Event
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

>=75% Accurate Prediction

Event 3
e.g. Knee xray

T-(24+y) mos.

T-(24+x) mos.

T-24 mos.

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

Average incidence time versus HF (years)
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**…

- 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!