

Advanced Clinical Analytics & Predictive Modeling
Swati Abbott, President, Elsevier / MEDai

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Enhancing healthcare, improving quality and reducing costs with award-winning predictive analytics and data mining.

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Presenter

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Agenda

- Who We Are
- Essentials of Analytics
 - Data
 - Severity Adjustment
- Analytics in Action: A Clinical Example
- Predictive Modeling
 - What is Predictive Modeling?
 - How is Predictive Modeling Done?
 - Application of Predictive Modeling

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Who we are



Elsevier, the Science, Technology & Medical (STM) division, is the leading provider of high quality scientific, technical and medical information to the academic, research and healthcare communities.

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Clinical Decision Support

Elsevier Clinical Decision Support is a division of Health and Science dedicated to providing quality electronic health care solutions and services. Whether improving healthcare workflow, building competency through our eLearning solutions or providing intelligence through data mining and predictive analytics, our aim is to improve the quality, safety and cost effectiveness of patient care.

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Leader in healthcare analytics and data transformation offering award-winning solutions for the improvement of healthcare delivery. Utilizing cutting-edge technology, payers and providers can predict patients at risk, identify cost drivers for their high-risk population, forecast future health plan costs, evaluate patient patterns over time and improve outcomes.

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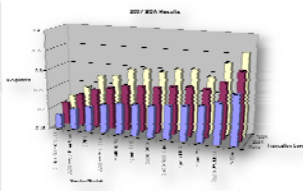
Award-Winning Analytics

Data Mining

Knowledge Discovery & Data Mining (KDD) Cup
International or National First Place for an unprecedented four years running

University of California Data Mining Competition
2005 Winner – Predicting Credit Risk (sponsored by Fair Isaac)

German Classification Society
2005 Winner – Predicting Liquidity Crisis




Predictive Analytics

2007 Society of Actuaries-Health Risk Assessment Study
Highest R2 and lowest Mean Absolute Predictive Error (MAPE)

BlueCross Blue Shield Association
Preferred Vendor for Predictive Modeling

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Essentials of Analytics



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Essentials of Analytics

- Data
 - Clinical Data
 - ADT
 - EHR
 - Pharmacy
 - Claims Data
 - Billing

Severity Adjustment Methodology



- Traditional Severity Adjustment Model
 - APR-DRG developed by 3M
- Disease Specific Severity Adjustment
 - Elsevier / MEDai Severity

Elsevier / MEDai Patient Severity

Two types of Severity Classification for each patient

- Disease Severity
 - A Disease Specific Classification of 1-5 within each of the 60+ diseases
 - Used for Standard Reporting within Diseases using Red/Green approach
 - Covers 100% of inpatients
- Patient Severity
 - A General Severity of 1-5 for the Patient
 - Used for Ad hoc reporting
 - Calculation is done incorporating
 - Relative Weights for all diseases & demographics & other variables
 - That patient's individual disease severity

Disease Specific Severity Models




Least Severe ← 1 2 3 4 5 → Most Severe

- Disease Specific Models
- Severity Index Categories
- Severity Modeling methodology

Data-Driven Models used to determine which factors have the most influence in driving severity within each of the 60+ diseases

Pneumonia as an example


- A large dataset is analyzed of patients with a pneumonia primary diagnosis
- Outcome measures are created for pneumonia that represents severity
 - LOS, Mortality, and multiple organ failures are included.
 - The idea is that pneumonia patients with longer LOSs, death, or organ-failure generally represent the most severe pneumonia patients
- A large database of pneumonia patients from many types of facilities is utilized
 - A comparison is done on the above-mentioned outcome measure to multiple patient factors such as demographics, various comorbidities, and many disease-specific diagnoses.
 - This mathematical comparison allows determination of which factors correlate most strongly to the outcome of death/LOS/organ-failure.
- For pneumonia, this analysis showed that the following factors had high correlation to LOS/death/organ failure
 - older age / history of COPD / pneumonia etiologies like staph/strep/aspiration / smoker / diabetes history
 - These are not all of the factors but represent some of those with high weights for driving severity
- Factors that best drive severity are known for the disease of pneumonia and the corresponding weight for each of those factors we can use these diagnostic factors for any future individual pneumonia patient to calculate whether their severity level will be a 1, 2, 3, 4, or 5

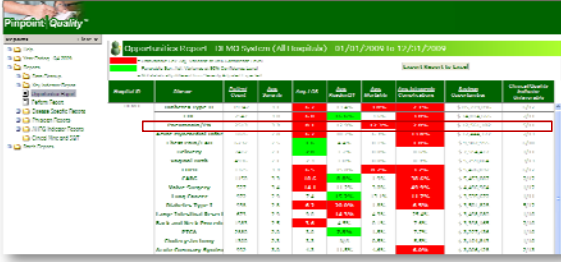


Analytics in Action: A Clinical Example

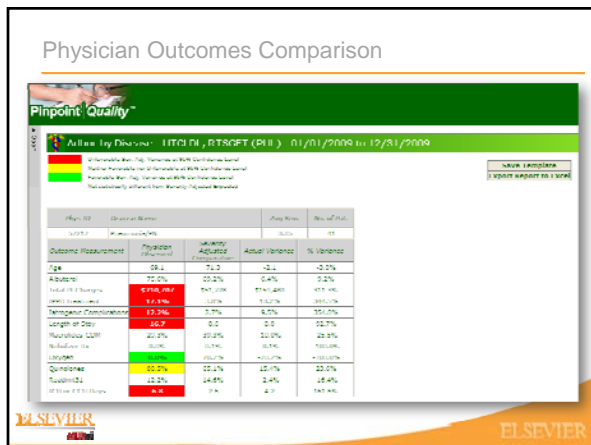
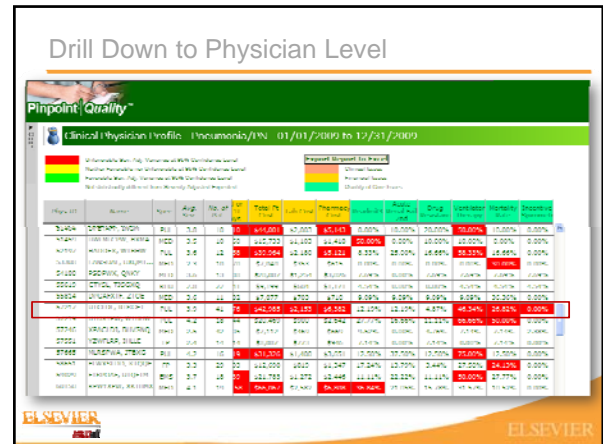
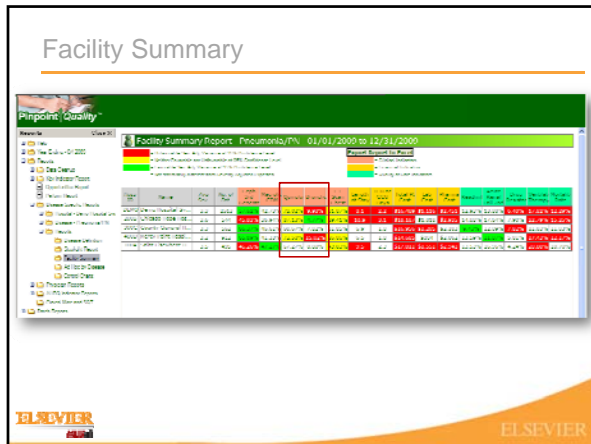
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Executive Dashboard



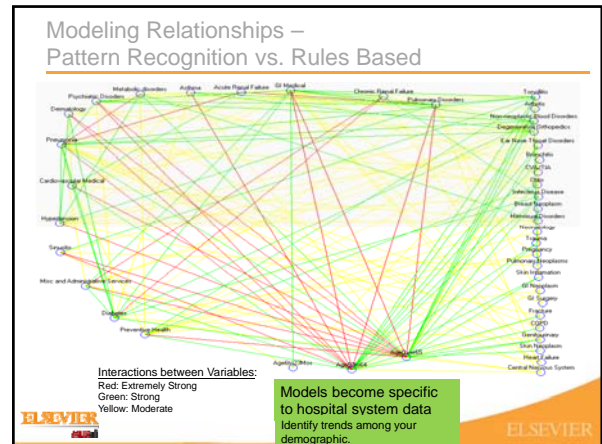
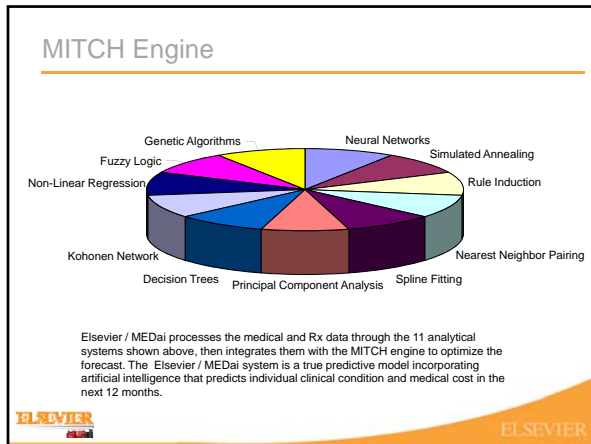
Looking Forward: Predictive Modeling

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What is "Predictive Modeling"?

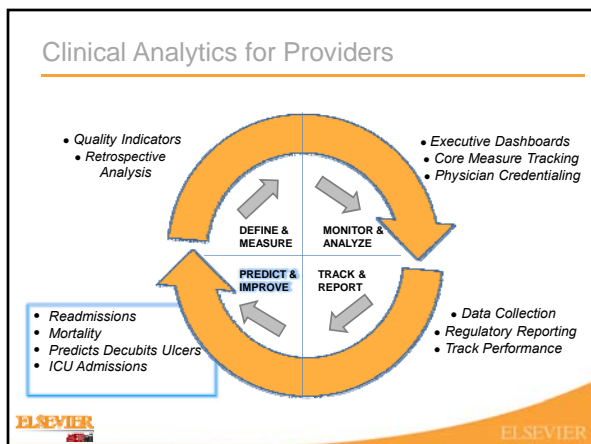
Predictive modeling is a process used in predictive analytics to create a statistical model of future behavior. Predictive analytics is the area of data mining concerned with forecasting probabilities and trends.

- ### Application of Predictive Analytics in Healthcare
- Patient Level Predictions for Population Management
 - Fraud Detection
 - Underwriting
 - Risk Management



- ### US HealthCare Reform increases pressure on Key Stakeholders
- Payers
 - Claims volume will increase
 - MLR target limit
 - Increase rate pressure
 - Providers
 - Manage risk : Pay for Performance/ACO model/Patient Centred Medical Home
 - EHR Adoption
 - Pressure to improve quality, outcomes, and cost
 - Increased reporting : JCAHO, CMS, Meaningful Use



- ### Dealing with the Health Care Cost Crisis: Shift Risk to Providers and Consumers
- Providers
 - Decrease payments
 - Increase performance measurement
 - Consumers
 - Increase premiums
 - Increase “one size fits all” cost sharing for clinician visits, diagnostic tests and prescription drugs



- ### Real-time Clinical Surveillance and Forecasting
- Identify Patients at Risk for Preventable Re-admit and Decubitus Ulcer
 - High Risk: Stratify all patients at risk using probability scores
 - Movers: Identify patients with a change in risk
 - Why?: View risk drivers to identify prevention strategy
 - Provide Near Real-time Clinical Surveillance
 - Intelligent Alert feature with customized alert delivery options
 - Powerful data filtering features
 - Reporting by Hospital, Admitting Physician, Unit/Nursing Station, Diagnosis
 - Use EHR data
 - Vital Signs
 - Lab Results
 - Pharmacy
 - Procedures
 - Central Supply



Elsevier / MEDai Models

- **Current Predictive Models**
 - Decubitus
 - Preventable Readmits
 - LOS - Predicted LOS in hospital or ICU. 1 day, 2-5 day, 5-9, >10
 - Mortality - Probability patient will expire in the hospital
 - ICU Admission - Probability patient will be transferred to higher care unit, such as ICU (1-5, 1 lowest prob.)



Preventable Readmit Risk Drivers

- Newborn Delivery Multiple prior admissions
- High creatinine High ammonia High HBA1C.
- Very Low Oxygen Sats.
- Age Admitting Physician is Pulmonologist or Infectious diseases
- Prior CHF Prior Traumatic stupor & coma Prior Nutritional Disorders
- Diabetic Drugs. Diuretics. Steroids. Narcotics.



ICU Admission risk drivers

- Prior Visits Severity Admission acuity Neonate / Adult
- Count of Vital signs and Labs with abnormal results
- Admitting Physician Specialty
- Count of cardiovascular drugs Vitamin K AntiParkinson Drugs Anesthetic Drugs
- GI Obstruction Surgery



Mortality risk drivers

- OR LOS Clustered High Risk Conditions (ie Severe Diagnoses like CHF/Stroke/COPD /Sepsis/Acites & multiple abnormal Labs or Vital Signs) Pregnancy / Delivery Mothers / Newborn Prior Visits
- Age, Sex, Marital Status
- Admitting Physician Infectious Disease or Internal Medicine
- Count of labs with abnormal-high results High troponin, ammonia, PT-INR, CKMB Abnormal WBC
- HighTemp, Low saturation, systolic BP
- Count of distinct drugs Lipotropics Bronchodilator
- Major Joint Replacement GI Obstruction Surgery



Decubitus Ulcer Risk Driver Examples

- Prior decubitus Prior discharge to SNF
- Age Operating Room LOS Admit Phys Pulmonary or Infectious Disease Multiple Prior Visits
- High WBC
- Senility & Degenerative Cerebral Disorders Prior UTI Prior Incontinence Obesity
- Antidepressant or AntiConvulsant Drugs

LOS Risk Driver Examples



- Age Group Categories Delivery Mothers Baby
- Prior LOS Prior ICU LOS Prior Oncology LOS
- High WBC High BUN Low PH
- High Temp
- Prior UTI GI Obstruction Surgery Very Severe Infection Diagnosis
- Number of Drug Classes Antidepressants Bronchodilators Diabetic Drugs Tranquilizers or Narcotics Anti-virals Steroids
- Obesity or Smoker Admit Phys Infectious Disease Previous Discharge SNF, home or hospital



High Level Summary of Modeling Accuracy
More detailed accuracy statistics will be presented thru-out this presentation

	Decubitus	Preventable Readmit	Mortality	ICU Admit	LOS
Accuracy (% of Testset receiving a correct prediction)	99%	90%	97%	82%	R2=0.22
Sensitivity	29%	44%	31%	40%	35%
Specificity	99%	83%	98%	89%	93%

Accuracy For the whole test set (%) were predicted correctly
Sensitivity Of all the high risk actuals in the test set (%) were predicted correctly
Specificity Of all the low risk actuals in the test set (%) were predicted correctly





Questions



Post Webinar Survey

- Watch your email!
 - Survey link will be included in a follow up email after this webinar
- Attendees must respond to the survey to ensure CEU credits



Contact Us

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