Predictive Analytics in Action: Tackling Readmissions

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Agenda

• Background
• Lifecycle
• Current status
• Discussion
Goals for today

• Describe how Allina Health is using data warehousing, predictive analytics, innovative care and technology investment to reduce the number of potentially preventable readmissions within the system.

• Leave plenty of time for discussion

• Learn from you (through your questions and feedback)
About Allina Health

- Largest Healthcare System in the Twin Cities
- 11 hospitals
- 1,658 staffed beds
- 60 Allina Clinics, 22 hospital-based clinics
- 15 community pharmacies
- 4 ambulatory care centers
- Specialty Operations: Transportation, Pharmacy, Lab, Homecare/Hospice
- About 22,800 employees, including 1,200+ employed physicians
- About 5,000 Community Physicians

Key statistics
- $3.2 billion in revenue
- 120,000+ inpatient admissions
- 1.0 million+ outpatient admissions

- 5.3 million, growing at 0.5% annually
- 3.2 million, growing at 0.75% annually
Allina’s EHR: Excellian

One Patient. One Record.

- First Hospitals and clinics implemented in 2004. All hospitals and clinics complete – Enterprise Applications
- Currently implementing Lab system
- 3 million patient records
- Storage Size: 1.9 terabytes – (adding 4 gig/day)
- 250,000 MyChart users, including e-Visits
- 30,000 Excellian users
- Received the 2007 HIMSS Davies Award for implementation
- Received Stage 6 (Hospital) on the EMR Assessment Model
- Attested for Meaningful Use Stage 1, Year 1 and 2
About the Data Warehouse

• Development
  - In-house, supplemented by outside expertise
  - Began in 2008, provided value to Allina within months

• Current Team
  - 10 x Data Architects (“Data Warehouse Generalists”)
  - 3 x BI Developers (“Data Visualization”)
  - 2 x BI Systems Admins (“Keeping the Lights On”)
  - 1 x Trainer
  - 1 x Manager

• Utilization
  - > 150 active “power” users/month
  - > 500 ad-hoc user queries/day
EDW Data Content

From Epic
- Patient Demographics and Identifiers
- Surgical Supplies/Implants
- Financial transactions (charges, payments, adj., etc.)
- Results (labs, etc.)
- Encounters and Vitals
- Admissions, Discharges, Transfers
- OR Cases and OR Log
- Ordered Procedures and Medications
- Administered Medications (MAR)
- Medical, Social HX, Problem List
- Flowsheets (subset), Questionnaires
- (lots more...)

Other Data Sources
- Pioneer ACO Claims
- HDM (3M Coding)
- Cost Accounting
- Tumor Registry
- Lumedx Apollo (CV Registries)
- Avatar (Patient Satisfaction)
- Premis
- Payroll
- Core Measures
Why are hospital and ED transitions important?

**Hospital & ED**
- Identify new illness
- Disease progression
- Scheduled intervention
- Treat
- Stabilize for discharge

**Discharge process**
- Identify resources
- Hand-offs
- Transition of care
- Communicate new issues
- Discharge instructions

**Ambulatory Care**
- Early follow-up appointments
- Follow through of hospital/ED plan
- Disease management

↓ **Length of Stay**
↓ **Readmissions**

↓ **ED Visits**
↓ **Readmissions**
↓ **Admissions**

Improve Quality, Patient Experience & Reduce Total Cost of Care
Project Drivers

• Increased readmission focus, statewide and nationally
• Analysis of potential gaps in the way our systems are currently hard-wired to transition patients out of the acute care setting
• Gaps:
  - Information sharing among providers for continuity of care
  - Identification of patients – who is in need of additional help and services?
  - Significant process variation across conditions
Initial Rollout ("Phase 1")

- Simple dashboard
- No predictive score
- Combination of “quasi real time” and historical data
- Agile development – simplest, easiest to build design which is still useful
- No big up, up-front design
- Lots of “shopping” to potential customers
Phase 1 - Architecture and refresh

12:46 PM
Epic

Reporting workbench:
Standard census report (csv)

12:55 PM
Flat file

SSIS Package:
Loads “Encounter.CurrentCensus”

1:00 PM
EDW

Dashboard refresh started:
- Census
- Historical data

1:05 PM
Dashboard refresh complete
Interest in predictive models

• Allina Health: Investing in predictive analytics
  - Better patient outcomes
  - At a lower cost, due to better resource allocation

• Data within the EDW was already well-vetted and used extensively for retrospective analyses

• Hypothesis: could we use the EDW in a proactive manner to improve patient care?
Overview of Readmission Risk Model

- **Objective:**
  - Create a predictive model accessible for clinicians to identify patients who would benefit from a “Transition Conference” to identify resources for the next level of care
    - Using a predictive model to identify and intervene with high risk patients can reduce hospital readmissions
  - Assigns a readmission risk score for 30 day readmissions

- **Data & Methodology:**
  - Nearly 2 years of data (Jan 2010 – Nov 2011)
    - 180k inpatient discharges (Allina wide).
  - Expanded to discharges of ‘All’ conditions
  - Hundreds of variables tested
  - Outcome by forwards and backwards stepwise multiple logistic regression.
    - 70% to train model, 30% to test. The train/test datasets were reassigned hundreds of times to determine confidence levels of final outcome statistics.
Variables Considered

- Demographic data
  - Age
  - Gender
  - Home zip code
  - Marital status
  - PCP clinic
  - Financial Class
  - Language
  - Discharge destination
  - Admit source type
  - Hospital location

- Clinical data
  - Encounter
    - BMI
    - Weight
    - Blood pressure
    - Pulse
    - Temperature
    - Depression (PHQ9)
    - Respiration
    - Etc.
  - Inpatient values
    - Nursing assessed functional status
    - Pulse oximetry values
    - Came through emergency department
    - Length of stay
    - Nursing DC assessments
    - Etc.

- Medications
  - OP Medication Count
  - IP Medication Count

- Lab
  - Cholesterol/Calcium
  - Red/white blood count
  - Creatinine/Hematocrit
  - Glucose levels/GFR
  - Hemoglobin/WBC/RBC
  - Other blood values

- 44 Diagnosis Groupings
  - If physician entered ICD9’s are present in the last 12 months
    - Asthma
    - Cancer
    - CHF
    - Gastro Intestinal
    - COPD
    - Depression
    - Diabetes
    - Renal Disease
    - Respiratory failure
    - Septicemia
    - Etc.

- Historical Utilization
  - Number of inpatients stays in the last 12 months
  - Number of emergency department visits in the last 12 months
  - Etc.
Test of Change ("Phase 2")

• Minor, but significant, dashboard enhancement – added the risk score with color coding at the patient level

• Intervention - Transition Conferences
  1. Identify potential candidates from dashboard
  2. Schedule conference(s)
  3. Facilitate conference(s)
Phase 2 - Architecture and refresh

12:46 PM

Reporting workbench:
Standard census report (csv)

12:55 PM

SSIS Package:
Loads “Encounter.CurrentCensus”

1:00 PM

Daily:
Risk score recalculation

EDW

Dashboard refreshed:
- Census
- Historical data
- Risk score

1:05 PM

Dashboard refresh complete
Wish us luck, it’s a demo.
Dashboard Acceptance

Sessions

Users

Distinct Users
Session Count

Post-Testing the Readmission Predictive Model…

- May 1st 2013 (over a year after Jan 2012 auto-calculating start for all patients)
  - 675,000 Risk scores
  - 157,000 Unique patients
  - 8,300 Unique patients in the high risk category

- 97% of patient’s risk scores have little or no change during the stay
  - 75% of patients will stay within the same risk level
  - 22% of patients will fluctuate between two neighboring risk levels

- 3% will fluctuate more significantly
  - Most increase due to major changes in patient status
  - Some due to data delays

- Validation suite was created to verify model accuracy changes over time and data input changes
Comparisons to published models

- Initial Goals
  - c-stat of > 0.7 (moderate discrimination power)
  - calibration error < 3%

<table>
<thead>
<tr>
<th>Model</th>
<th>LACE</th>
<th>CMS</th>
<th>Systematic Review*</th>
<th>Allina Health Readmission Predictive Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summary</td>
<td>4 variables: L=LOS, A=Acuity (was ED), C=comorbidity index, E=ED utilization</td>
<td>Claims based, many parameters</td>
<td>Varying depth and applicability</td>
<td>30 clinical and internal variables. Applies to all patients</td>
</tr>
<tr>
<td>C-stat</td>
<td>0.68</td>
<td>0.63 – 0.66</td>
<td>0.56 – 0.72</td>
<td>0.73</td>
</tr>
</tbody>
</table>

- JAMA “Risk Prediction Models for Hospital Readmissions”
  - 26 Unique models reviewed
    - 14 on claims data.
    - 9 of those 14 had low discrimination ability (c-stat 0.55 – 0.65)
    - 7 with moderate discrimination available during the stay (c-stat 0.56 – 0.72)
    - 5 at hospital discharge (c-stat 0.68 – 0.83)
  - Vary widely between the groups (one will work great with Asthma but not AMI...)
Why a transition conference?

• Patients and their families continue to experience readmissions

• Patient and caregiver engagement in discharge planning has been proven to decrease readmissions

• Using a predictive model within the EMR to identify and intervene with high risk patients can reduce hospital readmissions

• There are limited clinical resources; an efficient and systematic approach for complex discharge planning is needed

• Hospital payment is tied to readmissions

• New patient experience HCAPHS Care Transitions (CTM-3)
Readmission Rate Over Time

Readmission (PPR) Rate for Transition Conference Patients

PPR = Potentially Preventable Readmissions by 3M™
Transition Conference Summary

• First 800 Transition Conferences for High Risk
  - 15% reduction in PPRs
  - 10 Allina Health hospitals participated
• Impacts over 100 APR-DRGs
• More patients accepting post acute care
  - Ex. Home Health, SNF, Hospice, TCU
Challenges/Conclusions

• Technical Challenges
  - EDW morning load completion time
  - EDW SLA
  - Licensing

• Conclusions
  - Users find the tool useful and helpful
  - Shifted focus from identification to better care coordination
  - Ambulatory Care management
What questions or comments do you have?
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