Readmission Analytics: Yesterday, Today, and Tomorrow

Monday, June 3, 2:30 pm

In today’s regulatory arena, readmission analytics are a primary area of concern for hospitals, Long Term Acute Care Hospitals and Skilled Nursing Facilities. This presentation will reveal the anatomy of readmission analytics, including the common retrospective analytics used today by CMS and by many vendors with proprietary methodologies. An inspection of today’s "predictive readmission analytics" will also be presented, along with a glimpse into the future about the tools that will soon be available to case and quality management professionals to better manage patient’s real time in order to reduce potentially preventable readmissions.

CEU: NAHQ

Presented By:
Vicky Mahn-DiNicola, Vice President, Midas+ Solutions Strategy
Readmission Analytics
Yesterday, Today, and Tomorrow

Vicky Mahn-DiNicola RN, MS, CPHQ
Vice President, Midas+ Solution Strategy

Session Objectives

1. Compare and contrast readmission analytics developed by Midas+ and CMS
2. Describe the scoring program tied to the Hospital Readmission Reduction Program
3. Review the 3M Potentially Preventable Readmissions methodology
4. Discuss predictive analytics models emerging in today’s marketplace and how to interpret their “predictive power”
5. Suggest workflow and dataflow requirements for “next generation” prescriptive analytics
Process for Evaluating Readmissions

- All Medical Records "pulled" for 50 patients
- Manual review of over 200 charts
- Arbitrary decisions made about which readmissions were expected vs. not expected
- Data findings were not easily verifiable
- Findings did not “match” readmission counts in our hospital information system
- HIS System readmission counts didn’t match those in Midas!
Backwards and Forward Readmission Rates

Hospital Encounter

Count of patients with previous encounter 30 Days Before Admission

Count of patients readmitted within 30 Days After Discharge
Current Measure Definition for MIDAS+ Readmission Metrics

Congestive Heart Failure Readmissions within 30 Days

Numerator Statement: Non-elective inpatients returning for any cause as an acute care inpatient within 31 days of discharge from previous encounter

Inclusion Criteria:
- Inpatient readmission for any cause back to same facility
- Day of discharge counts as zero
- Includes All Payer Types

Exclusion Criteria:
- Outpatients or inpatient encounters for rehab, psychiatric, SNF or hospice care
- Emergency Department admissions (encounter type emergency)
- Admission status equivalent to “elective”

Denominator Statement: Count of acute care inpatients with a principal ICD-9 discharge diagnosis code of heart failure (defined the same as Hospital Quality Reporting populations defined by TJC and CMS)

Exclusion Criteria:
- Non-acute care encounters for rehab, psychiatric, SNF or hospice care
- Inpatient delivery or newborn encounters
- Discharge disposition equivalent to death

Midas+ Defined

CHF - % Readmit within 30 Days
yields **five** qualifying patients in June

Drill-down takes you to the INDEX encounter, NOT the readmission
Measure Results Differ According to the Technical Specifications of the Measure

CMS Proxy 30-day Heart Failure Readmission Measure yields only one qualifying patient in June compared to the five patients in the Midas+ defined metric.
CMS Readmission Proxy Measure
Definition in MIDAS+
Heart Failure CMS Readmission Reduction - % Readmit within 30 Days

**Numerator Statement:** Readmissions as an inpatient for any cause within 30 days of discharge from previous encounter. If index encounter has more than one qualifying readmission within the 30-day period the index encounter is counted only once.

**Inclusion Criteria:**
- Inpatient readmission for any cause back to same facility within 30 days of discharge
- Day of discharge counts as zero

**Exclusion Criteria:**
- Outpatients or inpatient encounters for rehab, psychiatric, SNF or hospice care
- Emergency Department admissions (encounter type emergency)
- Inpatient delivery or newborn encounters

**Denominator Statement:** Count of acute care inpatients with a principal ICD-9 discharge diagnosis code of heart failure (defined the same as Hospital Quality Reporting populations defined by TJC and CMS)

**Exclusion Criteria:**
- Patients less than 65 years of age at admission
- Payer Type equivalent to Medicare (excluding Medicare Advantage)
- Encounter is a readmission within 30 days of discharge of the previous encounter
- Length of stay longer than 365 days
- All encounters with overlapping dates (all are ignored)
- Discharge disposition equivalent to death, discharge to outside acute care or Left AMA
- Non-acute care encounters for rehab, psychiatric, SNF or hospice care
- Inpatient delivery or newborn encounters

CMS Readmission Proxy Measures in MIDAS+ close but not identical to metrics calculated by CMS
CMS Readmission Measures

• Calculated from Medicare Part A and B Claims Data
• Include readmissions back to ANY facility not just YOUR facility
• Individual hospitals and vendors can’t replicate exactly
• Complex Risk Model
• Getting more complex!

Note: The Hospital Readmissions Reduction Program includes only subsection(d) hospitals and hospitals paid under section 1814(b)(3) (i.e. Maryland hospitals), while the IQR calculations include non-Inpatient Prospective Payment System (IPPS) hospitals such as critical access, territories, and cancer hospitals, as well as Veterans Health Administration (VA) hospitals. Consequently, your hospital’s results for AMI, HF, and PN may differ from those calculated for IQR because they are calculated using a different set of hospitals.
Multiple Readmissions

- If a patient has more than one admission within 30-days, only the first one is counted as a readmission.
- No hospitalization will be counted as both a readmission and an index admission within the same measure.
- However, because the cohorts for the various readmission measure populations are determined independently, a readmission in one measure may qualify as an index admission in another CMS readmission measure.

Variables Used to Adjust Data in CMS Risk-standardized Readmission Rates

### Variables Used
- Age
- Gender
- Cardiovascular disease*
- Comorbidities*  
  - Renal Disease
  - COPD, Asthma, Pneumonia
  - Fluid & electrolyte imbalance
  - Urinary Tract Infection
  - Psychiatric Disorders
  - Liver or biliary disease
  - Drug or alcohol abuse
  - Peptic Ulcer Disease
  - Decubitus Ulcers
  - Anemia

### Variables NOT used
- Admission source
- Discharge disposition
- Socioeconomic status

* Each clinical population, including the hospital-wide 30-day all cause readmission measure has slightly different variables for cardiovascular disease and comorbidities.
Fractional Blobs
Really??

The Statistical Methods used by CMS for risk adjustment are documented here:

www.hospitalcompare.hhs.gov/staticpages/for-professionals/ooc/statistical-methods.aspx

---

**Risk-standardized Readmission Rates**

Excess Readmission Ratio

- Predicted Readmission Rate
- Expected Readmission Rate

National Unadjusted Readmission Rate

Excess Readmission Ratio < 1 = lower-than-expected readmission rates (or better quality)

**Predicted Rate** = The number of readmissions predicted based on the hospital’s performance with its observed case mix. Predicted values are based on hierarchical logistic regression models that include variables about the patient, such as age, gender, comorbid diseases and indicators of patient frailty.

**Expected Rate** = The number of readmissions expected on the basis of the nation’s performance with that hospital’s case mix.
Interpreting QNET Reports
http://www.medicare.gov/hospitalcompare/

Interval performance with overlap on either side of the crude unadjusted national rate are reported as “same as” other hospitals.

Interpreting QNET Reports
http://www.medicare.gov/hospitalcompare/

Interval performance with overlap on either side of the crude unadjusted national rate are reported as “same as” other hospitals.
Interpreting QNET Reports
http://www.medicare.gov/hospitalcompare/

Interval performance completely to the right of the national crude unadjusted national rate are “worse than” other hospitals.

Interval performance completely to the left of the national crude unadjusted national rate are “better than” other hospitals.

Hospital-specific Reports

- Go to qualitynet.org for your hospital's HSR workbook
- Preview period started April 18, 2013
- Must be a QNET administrator to download into your secure inbox
Medicare Hospital Quality Chartbooks
Available to public at

- Regional variation
- Racial disparities
- Reasons for readmissions
- Proportion by Medicare
- Small hospital data
- Large hospital data
- Measure methodology

Are Readmission Rates Associated with Public Reporting?

Public reporting is not associated with a reduction in readmission rates...
Observation Stays On The Rise

Looks like we’re just readmitting patients as observation status!

Did the use of observation stays after hospitalization for AMI, heart failure, and pneumonia change with the start of public reporting?

Observation stays are a subset of return-to-hospital events that have recently garnered significant media attention. CMS defines observation stays as services furnished by a hospital which are reasonable and necessary to determine the need for a possible inpatient admission. CMS currently does not count these events as outcomes in the publicly reported readmission measures. Although CMS has noted an overall increase in observation stay utilization in recent years, observation stay trends related to hospitalization for AMI, heart failure, and pneumonia have not been specifically examined. There appears to be a slight increase in the number of observation stays without readmissions over the past three years following a hospitalization for AMI, heart failure, or pneumonia. However, this increase seems to have begun prior to public reporting.

Return-to-hospital rates after hospitalizations for AMI, heart failure, and pneumonia were stable from 2008 to 2010. Public reporting is not associated with a change in return-to-hospital rates.

Unlike return-to-hospital rates, rates of observation stays after hospitalizations for AMI, heart failure, and pneumonia increased for 3 PMSI-FL and 5 PMSI-FL for the period between 2008 and 2010. The start of public reporting in July 2008 is not associated with a change in observation stay utilization.

Official Start Date
For Hospital Readmission Reduction Program
October 1, 2012

Downward Trends in Acute MI 30-day Readmissions Reflected in DataVision Comparison Pool

Acute MI 30 Day Readmission Rate All Ages
Stable Trend in Acute MI 30-day Readmissions Reflected when Process Phase Added

Downward Trends in CHF 30-day Readmissions Reflected in DataVision Comparison Pool
Stable Trends Reflected in CHF 30-day Readmissions When Process Phase is Added

Stable Trend in Pneumonia 30-day Readmissions Reflected in DataVision Comparison Pool
Downward Trends in National Readmission Rates for Acute Care Inpatients ≥ 65 years of age Reflected in DataVision Comparison Pool

Official Start Date For Hospital Readmission Reduction Program October 1, 2012

Stable Trend in National Readmission Rates for Acute Care Inpatients ≥ 65 years of age when Process Phase for Public Reporting is Added

Two more quarters below the center line could indicate a statistical change in our process….too early to tell!
Recommended Reading
http://www.rwjf.org/content/dam/farm/reports/reports/2013/rwjf404178

The Revolving Door: A Report on U.S. Hospital Readmissions
An Analysis of Medicare Data by the Dartmouth Atlas Project
Stories From Patients and Health Care Providers by EveryMind Research & Communication

February 2013
Robert Wood Johnson Foundation

Thirty-Day Readmissions — Truth and Consequences
Karen E. Joynt, M.D., M.P.H., and Ashish K. Jha, M.D., M.P.H.

Reducing hospital readmission rates has captured the imagina-
tion of U.S. policymakers because readmissions are common and costly and their rates vary — and at least in theory, a rea-
sonable fraction of readmissions should be preventable. Policymak-
ers therefore believe that reducing readmission rates represents a unique opportunity to simultane-
ously improve care and reduce costs. As part of the Affordable Care Act (ACA), Congress directed the Centers for Medicare and

Critics to CMS 30-day Readmission Reduction Initiatives

1. Only a small proportion of 30-day readmissions are probably preventable.
2. Much of what drives hospital readmission rates are patient and community-level factors outside of the hospital’s control; e.g., mental illness, poor social support, and poverty.
3. Readmission rates have weak signaling value for identifying high-quality hospitals.
   - No clear link between readmission rates and quality of care.
   - Higher readmission rates can be the result of low mortality rates or good access to hospital care.
4. Hospitals are expending so much energy on readmissions they may forgo other important quality improvement efforts.
5. Readmissions 3 to 7 days after discharge are much more under the hospital’s control than 30-day readmissions.
6. Financial penalties for high readmission rates dwarf the penalties for higher mortality rates and unsafe care.


Calculating Financial Impact of Hospital Readmission Reduction Program

- Hospital Readmission Reduction Program began with October 1, 2012, discharges for initial populations Acute MI, Heart Failure & Pneumonia
- 2,217 hospitals will be assessed a penalty ranging from 0.01 to 1 percent of their Medicare revenue in FY 2013 (cap is increasing to 2% in 2014 and 3% in 2015)
- CMS reports reduction of > 70,000 readmissions in 2012 (19% to 17.2%)
- FY 2013 projected savings of approximately $280 to 300 million (or 0.3 percent) of total Medicare IPPS operating payments
- FY 2014 projects approximately $175 million (0.2 percent) reduction in payment to hospitals
Calculating Financial Impact for Your Hospital’s Performance in the Readmission Reduction Program

**Hospital's Base Operating DRG Amount**
(before any adjustments made by Value-based purchasing) \[ \times \]
**Adjustment Factor determined by the higher of Two Values**

- **Floor Adjustment Factor**
  - FY 2013: 0.9900
  - FY 2014: 0.9800
  - FY 2015: 0.9700

**Hospital Specific Adjustment Factor**

The GREATER value of the two becomes your hospital’s adjustment factor for any given fiscal year.

---

Steps to Calculate Your Hospital’s Adjustment Factor

**Adjustment Factor** = \[ 1 - \left( \frac{\text{Aggregate payments for excess readmissions}}{\text{Aggregate payments for all discharges}} \right) \]

**Step 1**: Calculate aggregate payments for all discharges.

(Current Base DRG payment \( \times \) Medicare Part A Volume
(July 1, 2008 to June 30, 2011))

\[
$7830 \times 27,601 = $216,115,830
\]
Steps to Calculate Your Hospital’s Adjustment Factor

**Step 2:** Go to Hospital Compare to obtain population volumes and calculate your hospital’s excessive readmission ratio (ERR) for Acute MI, Heart Failure and Pneumonia.

We will use this volume value in Step 3

We will use this ERR value in Step 3

**Step 3:** Calculate aggregate payments for excessive readmissions.

\[
\text{Aggregate payments for excess readmissions} = \left( \text{Base DRG payment} \times \text{Volume} \times (\text{ERR} - 1) \right)
\]

- Acute MI:
  \[
  (\$7830 \times 415) \times \left( \frac{20.6 \text{ Hospital}}{19.7 \text{ National}} - 1 \right) = $148,500 \text{ in Excess Payments}
  \]

- Heart Failure:
  \[
  (\$7830 \times 673) \times \left( \frac{25.6 \text{ Hospital}}{24.7 \text{ National}} - 1 \right) = $191,813 \text{ in Excess Payments}
  \]

- Pneumonia:
  \[
  (\$7830 \times 255) \times \left( \frac{21.5 \text{ Hospital}}{18.5 \text{ National}} - 1 \right) = $323,857 \text{ in Excess Payments}
  \]

Aggregate payments for excess readmissions = $664,170 Total Excess Payment

You have to have zero excess payments in all three populations in order to avoid a reduction in your hospital’s adjustment factor.
Steps to Calculate Your Hospital’s Adjustment Factor

**Step 4:** Plug in your numbers.

\[
\text{Adjustment Factor} = 1 - \frac{\text{Aggregate payments for excess readmissions}}{\text{Aggregate payments for all discharges}}
\]

\[
\text{Adjustment Factor} = 1 - \frac{\$664,170 \text{ from step 3}}{\$216,115,830 \text{ from step 1}}
\]

Adjustment Factor = 0.9693

Final Step to Calculating Your Hospital’s Adjustment Factor for the Hospital Readmission Reduction Program

**Step 5:** Compare your hospital’s adjustment factor to the floor adjustment factor for the selected fiscal year. The larger value becomes your hospital’s adjustment value!

Floor adjustment set at 0.9900 for FY 2013, 0.9800 for FY 2014, and 0.9700 for FY 2015 and subsequent fiscal years

\[
\text{Hospital’s Base Operating DRG Amount} \times \text{Adjustment Factor determined by Hospital’s Readmission Rates}
\]

\[
\text{Ratio} = 0.9693
\]

\[
\text{Floor Adjustment} = .9900
\]

Use the largest of the two values

\[
\$7830 \times .9900 = \text{Reduced Base DRG Payment to $7752 in FY 2013}
\]

Meaning an overall payment reduction of $78 in FY 2013 for each Medicare claim. In this example this could translate to lost revenue of approximately $717,600 the first year!
Proposed Changes to the Hospital Readmission Reduction Program

1. Add criteria to exclude “planned” readmissions from Acute MI, Heart Failure and Pneumonia measures beginning with discharges October 1, 2013
   a. Previously exclusions were limited to revascularization procedures in the Acute MI population only
   b. NQF endorsed Acute MI (NQF #0505) and Heart Failure (NQF #0330) Readmission measures in January 2013 and Pneumonia (NQF #0506) in March 2013.

2. Add 30-day COPD and elective Total Hip or Knee Arthroplasty Readmissions for Calculation FY 2015 Adjustments
   a. Acute exacerbation of COPD (4th largest Medicare diagnosis) and elective total hip and knee arthroplasty (represents the largest procedural cost in the Medicare Budget).
   b. NOT recommending to add CABG, PCI and other vascular conditions as previously recommended by MedPAC in 2007 because inpatient admissions for PCI and other vascular conditions are shifting to outpatient settings. Continuing to explore CABG for future inclusion.
Revised Step 3 to Calculate Your Hospital’s Adjustment Factor FY 2015 if Proposed Rule is Finalized in August 2013

Step 3: Calculate aggregate payments for excessive readmissions.

\[
\text{Adjustment Factor} = 1 - \frac{\text{Aggregate payments for excess readmissions}}{\text{Aggregate payments for all discharges}}
\]

\[
\text{Aggregate payments for excess readmissions} = \text{Base DRG payment} \times \text{Volume} \times (\text{ERR} - 1)
\]

\[
\text{Aggregate payments for excess readmissions} = \begin{align*}
(\$7,830 \times 415) \times (20.6 \text{ Hospital} / 19.7 \text{ National} - 1) &= $148,500 \\
(\$7,830 \times 673) \times (25.6 \text{ Hospital} / 24.7 \text{ National} - 1) &= $191,813 \\
(\$7,830 \times 255) \times (21.5 \text{ Hospital} / 18.5 \text{ National} - 1) &= $323,857 \\
(\$7,830 \times \text{number}) \times (\text{ERR} - 1) &= $\text{Excess Payments}
\end{align*}
\]

You have to have zero in all FIVE populations in order to avoid a reduction in your adjustment factor.

Adding Planned Readmission Exclusions to CMS Readmission Methodology Starting in 2013

- **Planned readmission algorithm**
  - added to all readmission measures to avoid penalizing hospitals for performing scheduled procedures within 30 days of discharge.
  - This method also avoids counting unplanned readmissions that occur after a planned readmission, but within 30 days of discharge from the index admission.
  - This modified measurement technique reduced hospital wide 30-day all cause readmission rates from **16.5% to 16.0%** in the July 1, 2011 to June 30, 2012 data set.
### Planned Readmission Exclusions

**Always Planned**
- Transplants (bone, kidney, organ)
- Cesarean section
- Normal pregnancy and/or delivery
- Forceps, vacuum and breech delivery
- Maintenance Chemotherapy
- Rehabilitation

**Potentially Planned**
*When discharge diagnosis of readmission is NOT acute or a complication of care*
- Laminectomy, spinal fusion
- Knee and hip replacement
- Limb amputation
- Thyroidectomy and endocrine surgery
- Lung resections
- Hernia repairs
- Oophorectomy, hysterectomy
- TURP, prostatectomy
- Colorectal and gastrectomy surgery
- Cardiac surgery (CABG, Valve Repair)
- Wound and burn debridement
- Laryngectomy, tracheostomy revisions
- **More!**

---

### Acute or Complication Categories
Determined by Using AHRQ Diagnoses CCS Codes

AHRQ Clinical Classification Software (CCS)

- Developed by AHRQ as part of the Healthcare Cost and Utilization Project (HCUP)
- Categorization scheme for ICD-9 diagnose and procedure codes
- Clusters over 14,000 diagnosis codes and 3,900 procedure codes into a manageable number of clinically meaningful categories
  - Single level diagnosis CCS: 285 mutually exclusive categories
  - Single level procedure CCS: 231 mutually exclusive categories
- Useful in research and statistical analysis
- Files downloaded and used with SAS or SPSS to convert ICD-9 codes to CCS codes
- Mental health populations have unique CCS-Mental Health and Substance Abuse (MHSA) tools

Impact on National Readmission Rates when Unplanned Readmissions are Excluded

<table>
<thead>
<tr>
<th>Condition</th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute MI</td>
<td>19.2%</td>
<td>18.2%</td>
</tr>
<tr>
<td>Heart Failure</td>
<td>24.6%</td>
<td>23.1%</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>18.5%</td>
<td>17.8%</td>
</tr>
</tbody>
</table>

For More Information on Readmission Measure Methodology

### Source Data

<table>
<thead>
<tr>
<th>Metric</th>
<th>Midas+ Defined Readmit Metric</th>
<th>Midas+ CMS Proxy Readmit Metric</th>
<th>CMS Unplanned Readmission Reduction Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital Discharge Abstract and ADT System interfaced into Midas+</td>
<td>Hospital Discharge Abstract and ADT System interfaced into Midas+</td>
<td>Medicare claims or VA administrative data (note: risk model for AMI, HF, PN, Hip and Knee uses inpatient, outpatient and physician carriers’ administrative data for the 12 months prior to initial encounter. Hospital wide rate uses only inpatient claims data)</td>
<td></td>
</tr>
</tbody>
</table>

| Limited to same hospital readmits | Yes | Yes | No |
| Expired on index admission | Denominator exclusion | Denominator exclusion | Denominator exclusion |
| Elective Admit Status | Numerator exclusion | Not applicable | Not applicable |

<table>
<thead>
<tr>
<th>Target Population</th>
<th>All Payers</th>
<th>Medicare as primary payer Age ≥ 65</th>
<th>Medicare Part A with AHRQ CCS to exclude Rehab, Psych &amp; Cancer Care Age ≥ 65</th>
</tr>
</thead>
<tbody>
<tr>
<td>Separate metrics for all ages and Age ≥ 65 years</td>
<td>Non acute care inpatients and maternal-neonatal stays excluded</td>
<td>Non acute care inpatients and maternal-neonatal stays excluded</td>
<td>(Note: Encounters with incomplete claims history 12 months prior to admission and less than 30 days post-discharge enrolled in Medicare are excluded)</td>
</tr>
</tbody>
</table>

| Left Against Medical Advice | Not applicable | Denominator exclusion | Denominator Exclusion |
| DC/Transfer to other acute care hospital | Not applicable | Denominator exclusion | Transfers attributed to the receiving hospital (readmissions attributed to the final hospital) |
| LOS > 365 Days | Not applicable | Denominator exclusion | Denominator Exclusion |
| Overlapping encounters | Not applicable | Denominator exclusion | Denominator Exclusion |
| Index encounter can be a 30-day readmit | Not applicable | Denominator exclusion (only one index admission within 30 days is allowed) | Denominator Exclusion (only one index admission within 30 days is allowed for AMI, HF, PN and Hip/Knee but allowed for Hospital Wide All Cause Readmission Measure) |
| Unplanned Readmissions | Not applicable | Not YET applicable | Denominator Exclusion |
| Risk Standardized | No | No | Yes (RSRR) |
Readmission Methodology Matters

27% of readmission are preventable
- 12% were deemed preventable in studies that used clinical data
- 59% were deemed preventable in studies that used only administrative data

Total number of readmissions vary substantially among hospitals, but the rate of preventable readmissions does not

3M Potentially Preventable Readmissions

- Proprietary methodology developed by 3M
  (requires software and a license with 3M or other third party vendor like Midas+)

- Populations are defined using APR DRGs
  (instead of ICD-9 defined populations used by CMS methodology)

- A "Preventable" readmission is determined by evaluating the relationship between the APR DRG assignment of the "Initial Admission" and the readmission
  (this is done by examining ICD-9 diagnosis and procedure codes, discharge status and other variables found in the administrative claims data)
### Clinical Relationship Reasons

Readmissions are assigned to one of 17 “buckets” when determining if an subsequent encounter is “potentially preventable”.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Medical readmission for a continuation or recurrence of the reason for the initial admission or for a closely related condition.</td>
</tr>
<tr>
<td>2A</td>
<td>Ambulatory care-sensitive conditions as designated by AHRQ.</td>
</tr>
<tr>
<td>2B</td>
<td>All other readmissions for a chronic problem that might be related to care either during or after the initial admission.</td>
</tr>
<tr>
<td>3</td>
<td>Medical readmission for an acute medical condition or complication that might be related to or might have resulted from care during the initial admission or in the postdischarge period after the initial admission.</td>
</tr>
<tr>
<td>4</td>
<td>Readmission for a surgical procedure to address a continuation or a recurrence of the problem that caused the initial admission.</td>
</tr>
<tr>
<td>5</td>
<td>Readmission for a surgical procedure to address a complication that might be related to or might have resulted from care during the initial admission.</td>
</tr>
<tr>
<td>6A</td>
<td>Medical health diagnosis after an initial admission for a non-mental health, non–substance abuse reason.</td>
</tr>
<tr>
<td>6B</td>
<td>Mental health or substance abuse readmission after an initial admission for a substance abuse or mental health diagnosis.</td>
</tr>
<tr>
<td>NC</td>
<td>Not clinically related</td>
</tr>
<tr>
<td>T</td>
<td>Trauma</td>
</tr>
<tr>
<td>C</td>
<td>Catastrophic</td>
</tr>
<tr>
<td>NP</td>
<td>Clinically related, not preventable</td>
</tr>
<tr>
<td>P</td>
<td>Probably planned readmission</td>
</tr>
<tr>
<td>E</td>
<td>Error</td>
</tr>
<tr>
<td>OB</td>
<td>Obstetrics</td>
</tr>
<tr>
<td>TR</td>
<td>Transplants</td>
</tr>
<tr>
<td>M</td>
<td>Malignancy</td>
</tr>
</tbody>
</table>

(continued)

Readmissions are assigned to one of 17 “buckets” when determining if an subsequent encounter is “potentially preventable”.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6C</td>
<td>Mental health diagnosis after an initial admission for a substance abuse or mental health diagnosis.</td>
</tr>
<tr>
<td>NC</td>
<td>Not clinically related</td>
</tr>
<tr>
<td>T</td>
<td>Trauma</td>
</tr>
<tr>
<td>C</td>
<td>Catastrophic</td>
</tr>
<tr>
<td>NP</td>
<td>Clinically related, not preventable</td>
</tr>
<tr>
<td>P</td>
<td>Probably planned readmission</td>
</tr>
<tr>
<td>E</td>
<td>Error</td>
</tr>
<tr>
<td>OB</td>
<td>Obstetrics</td>
</tr>
<tr>
<td>TR</td>
<td>Transplants</td>
</tr>
<tr>
<td>M</td>
<td>Malignancy</td>
</tr>
</tbody>
</table>
Readmission Chains

- Counts Readmission Chains vs. Encounter Pairs
  - A readmission chain is a sequence of Potentially Preventable Readmissions that are all clinically related to the initial admission.
  - A readmission chain can consist of an Initial admission and only one PPR, which is the most common situation, or can include multiple PPRs after initial admission.

Chains Can Be Broken When:

- Readmissions are not clinically related to the Initial Admission
- Clinically related, but not preventable
- Admission date exceeds the time interval from the preceding admission's discharge date
- Readmission with a status of
  - Left against medical advice
  - Expired
- Occurrence of an excluded admission
  - Malignancy
  - Neonatal
  - Human Immunodeficiency Virus
  - Trauma and burn
  - Other global exclusions such as cystic fibrosis, eye procedures/care
  - Obstetrics
- Age combined with specific APR DRG
  - For example, APR DRG 248 Major gastrointestinal and peritoneal infections if less than 6 years old
Midas+ Indicator Pairs vs. 3M PPR Chains

Midas+ All Cause Readmission
- Count all subsequent admissions in the time interval
- Midas CMS HRRP Indicators count one readmission in each 30-day time interval
- Pair an initial encounter with a readmission encounter
- Are not risk- or severity-adjusted

3M PPRs
- Count chains of clinically related admissions in the time interval
- Link an initial admission with clinically related readmissions until the chain is terminated
- Based on APR DRG risk- and severity-adjustment methodology

30-day PPR Example

<table>
<thead>
<tr>
<th>APR DRG</th>
<th>Encounter</th>
<th>Clinical Relationship</th>
<th>Days Between</th>
<th>Admit Date</th>
<th>DC Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>194</td>
<td>Heart failure</td>
<td>Initial admission</td>
<td></td>
<td>01-Jan</td>
<td>05-Jan</td>
</tr>
<tr>
<td>194</td>
<td>Heart failure</td>
<td>Medical readmission for an acute medical condition or complication that might be related</td>
<td>5</td>
<td>10-Jan</td>
<td>12-Jan</td>
</tr>
<tr>
<td>200</td>
<td>Cardiac structural and valvular disorders</td>
<td>All other readmissions for a chronic problem that might be related</td>
<td>7</td>
<td>19-Jan</td>
<td>21-Jan</td>
</tr>
<tr>
<td>207</td>
<td>Other circulatory system diagnoses</td>
<td>Medical readmission for an acute medical condition or complication that might be related</td>
<td>26</td>
<td>16-Feb</td>
<td>20-Feb</td>
</tr>
</tbody>
</table>

Chain 1
### 30-day PPR Example

<table>
<thead>
<tr>
<th>APR DRG</th>
<th>Encounter</th>
<th>Days Between</th>
<th>Admit Date</th>
<th>DC Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>194</td>
<td>Heart failure</td>
<td>5</td>
<td>10-Jan</td>
<td>12-Jan</td>
</tr>
<tr>
<td>200</td>
<td>Cardiac structural and valvular disorders</td>
<td>7</td>
<td>19-Jan</td>
<td>21-Jan</td>
</tr>
<tr>
<td>207</td>
<td>Other circulatory system diagnoses</td>
<td>26</td>
<td>16-Feb</td>
<td>20-Feb</td>
</tr>
<tr>
<td>194</td>
<td>Heart failure</td>
<td></td>
<td>25-Mar</td>
<td>31-Mar</td>
</tr>
<tr>
<td>463</td>
<td>Kidney/Urinary Tract Infection</td>
<td>10</td>
<td>10-Apr</td>
<td>12-Apr</td>
</tr>
</tbody>
</table>

**Chain 1**

**Chain 2**

- CMS will only count one readmission pair within 30 days. No encounter can be both an index encounter and a readmission encounter.
### Midas+ DataVision CHF 30-day Readmission Indicator Pairs vs. PPR Chains

<table>
<thead>
<tr>
<th>APR</th>
<th>DRG</th>
<th>Encounter</th>
<th>Days Between</th>
<th>Admit Date</th>
<th>DC Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>194</td>
<td>194</td>
<td>Heart failure</td>
<td>01-Jan</td>
<td>05-Jan</td>
<td></td>
</tr>
<tr>
<td>194</td>
<td>194</td>
<td>Heart failure</td>
<td>10-Jan</td>
<td>12-Jan</td>
<td></td>
</tr>
<tr>
<td>200</td>
<td>200</td>
<td>Cardiac structural and valvular disorders</td>
<td>19-Jan</td>
<td>21-Jan</td>
<td></td>
</tr>
<tr>
<td>207</td>
<td>207</td>
<td>Other circulatory system diagnoses</td>
<td>16-Feb</td>
<td>20-Feb</td>
<td></td>
</tr>
</tbody>
</table>

Midas+ will count the second Heart Failure encounter because it was a qualifying encounter for the population of interest. If the second case had been RENAL failure this case would NOT have been counted.

### CMS All Cause 30-day Readmissions vs. PPR Chains

<table>
<thead>
<tr>
<th>APR</th>
<th>DRG</th>
<th>Encounter</th>
<th>Days Between</th>
<th>Admit Date</th>
<th>DC Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>194</td>
<td>194</td>
<td>Heart failure</td>
<td>01-Jan</td>
<td>05-Jan</td>
<td></td>
</tr>
<tr>
<td>194</td>
<td>194</td>
<td>Heart failure</td>
<td>10-Jan</td>
<td>12-Jan</td>
<td></td>
</tr>
<tr>
<td>200</td>
<td>200</td>
<td>Cardiac structural and valvular disorders</td>
<td>19-Jan</td>
<td>21-Jan</td>
<td></td>
</tr>
<tr>
<td>207</td>
<td>207</td>
<td>Other circulatory system diagnoses</td>
<td>16-Feb</td>
<td>20-Feb</td>
<td></td>
</tr>
</tbody>
</table>

CMS will only count one readmission pair within 30 days. No encounter can be both an index encounter and a readmission encounter.
**Midas+ DataVision % Readmit to Acute Care within 30-day Readmission vs. PPR Chains**

<table>
<thead>
<tr>
<th>APR DRG</th>
<th>Encounter</th>
<th>Days Between</th>
<th>Admit Date</th>
<th>DC Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>194</td>
<td>Heart failure</td>
<td>01-Jan</td>
<td>05-Jan</td>
<td></td>
</tr>
<tr>
<td>194</td>
<td>Heart failure</td>
<td>5</td>
<td>10-Jan</td>
<td>12-Jan</td>
</tr>
<tr>
<td>200</td>
<td>Cardiac structural and valvular disorders</td>
<td>7</td>
<td>19-Jan</td>
<td>21-Jan</td>
</tr>
<tr>
<td>207</td>
<td>Other circulatory system diagnoses</td>
<td>26</td>
<td>16-Feb</td>
<td>20-Feb</td>
</tr>
<tr>
<td>194</td>
<td>Heart failure</td>
<td>33 - Initial</td>
<td>25-Mar</td>
<td>31-Mar</td>
</tr>
<tr>
<td>463</td>
<td>Kidney/Urinary Tract Infection</td>
<td>10</td>
<td>10-Apr</td>
<td>12-Apr</td>
</tr>
</tbody>
</table>

DataVision counts the initial qualifying encounter for each readmission pair.

**Benefits of 3M PPR**
- All payer
- Risk adjusted so tends to be more accepted by clinical stakeholders
- Focuses on cases that you can affect through improved clinical and care management processes
- Helps you identify benchmarks and target thresholds for your key populations
- Optimally used with APR DRG LOS and Mortality findings to understand changing populations

**Benefits of DataVision**
- More inclusive data set that can be integrated into worklists for early alerts and notifications
- Easy drill-down to patient and provider detail
- Integrated with Readmission Toolpack so that patterns will be highly transparent

……but both these methodologies are still retrospective
Variables presumed to impact hospital readmissions

- Premature discharge
- Poor patient compliance
- Age of the patient
- Male sex
- Chronic disability
- Patient living alone
- Unavoidable relapse
- Inadequate medical management

- Poor self-rated general health
- Inadequate rehabilitation
- Poor discharge planning
- Inadequate follow up care
- Cognitive impairment
- Ethnic disparities
Landmark Article
Reveals current methodologies lack discrimination that are not likely to be reliable enough to use in day-to-day operations.
Free and available to public

Readmission Risk Calculators
Select a Reason for Initial Hospitalization:

- Heart Attack
- Heart Failure
- Pneumonia

Readmission Risk Score for Heart Failure
This readmission calculator is based on a statistical model developed from chart abstracted data. It is intended for use with patients age 65 and older.

DEMOGRAPHICS
Age 72 years
Sex Male

PRESENTATION
In-hospital Cardiac Arrest Yes

HISTORY
Diabetes Yes
Heart Failure Yes
Coronary Artery Disease Yes
Prior PCI No
Aortic Stenosis Yes
Stroke, ischemic or hemorrhagic Yes
COPD Yes
Dementia Yes

PHYSICAL EXAM ON ADMISSION
Systolic Blood Pressure 165 mmHg
Heart Rate 64 beats per min
Respiratory Rate 22 beats per min

DIAGNOSTICS ON ADMISSION
Sodium 134 mEq/L
Blood Urea Nitrogen 28 mg/dL
Creatinine 2.4 mg/dL
Hemoglobin 48 g/L
Glucose 132 mg/dL
LV Ejection Fraction 34%

Manually Enter Demographics and Health History, Vital Signs, and Lab Results

Calculate Readmission Risk Score Clear all Data
How Accurate Are These Tools?

Statistical Model for Prediction = ROC Curve 0.60 to 0.63

Statistical Primer for Predictive Analytics

Four possible outcomes in Predictive Analytics

- True Positive (Sensitivity)
- False Positive (Specificity)
- False Negative
- True Negative
Statistical Primer for Predictive Analytics

Four possible outcomes in Predictive Analytics

- True Positive (Sensitivity)
- False Positive (Specificity)
- False Negative
- True Negative

Patient tests positive for the disease but doesn’t really have it!

Patient tests negative suggesting they are healthy but they actually have the disease.
Statistical Primer for Predictive Analytics

True Positive (Sensitivity)  False Positive (Specificity)

False Negative  True Negative

100% 0%

True Positive Rate

False Positive Rate

1.0 = Perfect

Line of no-discrimination

0.05 = Random Coin Toss

ROC Curve is the Area Under the Line
Also known as the C-Statistic

Points above the Diagonal line Represent better Than random

Points below the Diagonal line Represent Worse Than random
CMS Readmission Calculator
C-Statistic = .60 to .63

Acute MI = .63
Heart Failure = .60
Pneumonia = .63

Other Predictive Analytic Tools

• LACE Assessment
  - Length of Stay
  - Acute Admit via ED
  - Comorbidities (modified)
  - ED visits in past six months

C Statistic = .70 but data must be collected POST Discharge so usefulness to identify patients in-house for proactive management is limited
Other Predictive Analytic Tools

- Probability of Repeated Admission Instrument (Pra™)
  - 17 item questionnaire
  - Medical history
  - Functional ability
  - Living circumstances
  - Nutrition
  - Depression
  - Licensing available from Johns Hopkins

Tells me about estimated risk of readmission for this patient but not what to do about it

C Statistic = .53 to .61 depending on which study you review
Published in Kansagara (2011) systematic review paper

What are the interventions presumed to reduce readmissions?

- Define and arrange post discharge medical services
- Define and arrange post discharge ancillary services e.g. PT, OT, Home Health
- Review medication changes
- Self care education and coaching
- Provide readable copy to patient and family
- Send discharge plan of care to all providers
- Red flag symptoms
- Assess home safety and ADLs
- Follow up call to Patient/Family
Midas+ PARC – Early Findings in Readmission Predictives

**Approach:**
- Predictive analytics applied to hospital encounter data (Real-time Admission Discharge Transfer and Discharge Abstract Data)
- Prelim: two years of data, 100 hospitals (~2.2M records)
- Machine learning classifier automatically identifies relevant factors, can adapt to hospital-specific population

**Insight:**
- Achieved c-statistic for individuals of >0.72, expect more with tuning
- Many factors are relevant (sample): age, length of stay, number of diagnoses, time of day of discharge, principal diagnosis
- Gender, time of day of admission, principal procedure NOT relevant
- Opportunity to analyze discharge supports for specific populations to create prescriptive analytics integrated with Midas+ workflow tools
Closing Thoughts

- Readmissions are proxy measures of quality of care.
- Not all readmissions are undesirable.
- Not all readmissions are preventable.
- A certain percentage of readmissions can be influenced by proper medical management, discharge planning and continuity of care.
- The ultimate purpose of readmission rates are to help you identify those patients and conditions for whom you can most likely make a difference.
- Different readmission metrics will give you different results.
- Advanced computer science and machine learning are likely to emerge to bring us prescriptive analytics to better manage readmissions in the future.
Time for a Break!