Unraveling the Mysteries of Severity Adjustment

A detailed review will be presented of specific MIDAS+ DataVision enhancements that support the analysis of key populations using APR DRG data.

Presented by:
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Medical Director
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Severity Adjustment

Henry Johnson MD MPH
Medical Director
ACS MIDAS+

Ask Questions:

“What do you mean by . . . .?”
Outline

• What do we mean by severity adjustment?
• Why do we want to do it?
• How can we do it?
• 3M APR-DRG
• Applications
What do we mean by Severity Adjustment?

• A term used almost exclusively for clinical data
  – A way of “adjusting” for different levels of “illness” within a population of interest

• In Epidemiology, commonly known as Risk Adjustment
  – The dependent variable is your outcome of interest, the independent variables are the “Risk Factors” for the outcome, with or without causality

Severity Adjustment

Outcome of Interest ~ One or more independent variables

Deaths/100,000 per year ~ Age

Deaths/1000 acute care admissions per year ~ Age, Principle Diagnosis, Secondary Dxs, Procedures

Hospital Resource utilization ~ Principle Diagnosis, Secondary Dxs, Procedures
**Why do we want to do it?**

- **Research**
  - Clinical trials
    - Adjust for independent variables not related to intervention or drug under study
  - Health Services
    - Public health / Epidemiology
    - Healthcare utilization and outcomes
- **“Day to Day operations”**
  - Hospital, County, State, Region, Country

**“My patients are sicker”**

- “I get more train wrecks from ________”
- “All my patient have ____________”

- “The Population of patients I care for have certain independent variables [risk factors] that make them more likely to [die, or stay in the hospital a long time, use a lot of resources.]”
Day to Day Operations:

- **Comparisons over time**
  - Track changes internally, and compare with State, Region, National
- **Comparisons between groups during the same time**
  - External: Hospitals, Counties, Regions
  - Internal: Physicians
- **Reimbursement**
  - Federal DRG’s

How can we do it?

- **Research:**
  - Stratification or Regression
  - Do it yourself
- **Operations:**
  - Stratification or Regression
  - You need a standard methodology if you want to compare your hospital to others
    - Therefore, not really useful to do it yourself

Next, one slide on Regression
Logistic regression

From Wikipedia, the free encyclopedia

Logistic regression is a statistical regression model for binary dependent variables. It can be considered as a generalized linear model that utilizes the logit as its link function, and has binomially distributed errors.

The model takes the form

\[ \logit(p) = \log \left( \frac{p}{1-p} \right) = \alpha + \beta_1 x_1 + \cdots + \beta_k x_k \]

\[ i = 1, \ldots, n, \text{ where} \quad p = P(Y_i = 1). \]

The logarithm of the odds (probability divided by one minus the probability) of the outcome is modelled as a linear function of the explanatory variables, \( X_1 \) to \( X_k \). This can be written equivalently as

\[ p = P(Y_i = 1|X) = \frac{\exp(\alpha + \beta_1 x_1 + \cdots + \beta_k x_k)}{1 + \exp(\alpha + \beta_1 x_1 + \cdots + \beta_k x_k)}. \]

The interpretation of the \( \beta \) parameter estimates is as an multiplicative effect on the the odds ratio. In the case of a dichotomous explanatory variable, for instance sex, \( e^\beta \) (the antilog of \( \beta \)) is the estimate of the odds ratio of having the outcome for, say, males compared with females.

The parameters \( \alpha, \beta_1, \ldots, \beta_k \) are usually estimated by maximum likelihood.

Extensions of the model exist to cope with multi-category dependent variables and ordinal dependent variables.

Severity Adjustment Systems

- **DRG’s**
  - Creates groups of patients who are similar both clinically [clinical coherence], and in terms of consumption of hospital resources
  - Based on existing hospital abstracting systems
    - Age, Principal diagnosis, Secondary Diagnoses, and Procedures
  - Development: Yale 1970’s
    - Start with Major Diagnostic Categories (MDC’s) by organ system
    - MDC’s divided into surgical and medical
Severity Adjustment Systems

• DRG’s
  – October 1983: Medicare prospective payment system
    • DRG modifications directed by CMS and focused on elderly
  – Each DRG has a Relative Weight (RW) that represents the level of resources required by that category
    • Payment = RW x $41,13.00 (Iowa City 2005)
    • Allows calculation of Case Mix Index, Overall measure of resources required to care for the population

• AP(All Patient) DRG
  – 1987: New York passed prospective payment for all non-Medicare patients

• APS DRG
  – Different methodology, also developed from the DRG model

• APR DRG
  – All Patient Refined DRG’s

• Others:
  – STS, APACHE, Disease Staging, MedisGroups
**APR DRG**

- Expanding scope of Diagnostic Related Groups to add:
  - Severity of Illness: The extent of physiologic decompensation or organ system loss of function
  - Risk of Mortality: The likelihood of dying
  - Resource intensity

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**Development Process: Clinically Coherent with Sufficient case volume**

- Start with All Patient DRG’s
- Consolidate
  - Example: Pneumonia and Pleursy DRG 89(with CC) and 90(without CC)
- Pediatric additions
- Add APR-DRG’s for Mortality
  - Example: Specific CerebroVascular Disorders Except TIA [Federal DRG 14] sub-divided into:
    - APR-DRG 45: CVA with infarct and
    - APR-DRG 44: Intracranial hemorrhage (has higher mortality rate)
**APR DRG: Rerouting logic**

- Considers secondary diagnoses, procedures, and sometimes age, most often in conjunction with the principal diagnosis, and may reassign the APR DRG within, or across an MDC

- **Examples:**
  - PrinDx Chest Pain, 2nd Dx Angina
    - Reroute from 203 Chest pain to 198 (Angina Pectoris)
  - PrinDx Hypovolemia, 2nd Dx Gastroenteritis
    - Reroute from MDC 10, APR-DRG 422 Hypovolemia to MDC 6 APR-DRG 249 Non-Bt Gastroenteritis

**Subclass assignment**

- Assign each secondary diagnosis a Level from 1 to 4, both for Severity and Risk of Mortality
- In an iterative fashion, assign a Subclass number, based on dominate secondary diagnoses
- **Some modifications for age**
  - Hypertension in children is considered major as a secondary
- **Some modifications for APR DRG**
  - Chronic Renal Failure as a secondary is Moderate, except where the APR DRG is diabetes, in which case it is Major
Testing

• Once the clinical model for severity of illness and risk of mortality is developed for each base APR-DRG, it is evaluated with historical data to be sure the subclasses predict resource use (SOI), and mortality rate (ROM)
• Version 20.0 was evaluated against a national database of 8.5 million discharges, all payers, from 1,000 hospitals from 10 states, and 47 children’s hospitals in the U.S.

APR DRG v.20

• For each APR DRG subclass, a Relative Weight (RW) has been calculated that reflects the resources required for a patient in this APR DRG, and subclass
• This Subclass RW allows calculation of an overall Case Mix Index for the hospital, or by physician or physician group, which is severity adjusted
• Allows for more refined reimbursement
Unraveling the Mysteries of Severity Adjustment

15th Annual MIDAS+ User Symposium
May 22–24, 2006 • Tucson, Arizona

APR DRG v20: Relative Weights

Following is an example of the relative weights calculated for APR-DRG 194 (Heart Failure):

<table>
<thead>
<tr>
<th>Severity Subclass</th>
<th>Relative Weight</th>
<th>Base Rate RW</th>
<th>Payment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (Minor)</td>
<td>0.5804</td>
<td>$4,113.00</td>
<td>$2,387.19</td>
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<tr>
<td>2 (Moderate)</td>
<td>0.7930</td>
<td>$4,113.00</td>
<td>$3,261.61</td>
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<tr>
<td>3 (Major)</td>
<td>1.2736</td>
<td>$4,113.00</td>
<td>$5,238.32</td>
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<tr>
<td>4 (Extreme)</td>
<td>3.0052</td>
<td>$4,113.00</td>
<td>$12,360.39</td>
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</table>

In this example, the heart failure patients assigned a severity subclass of extreme is expected to have total charges that are three times as high as the average total charge of all patients in national database.

Progression of Subclasses and RW’s by 2nd Dxs

Table 1—Comparison of CMS DRG and APR DRG weights (2001 National norm)

<table>
<thead>
<tr>
<th>Case 1</th>
<th>Case 2</th>
<th>Case 3</th>
<th>Case 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prim dx</td>
<td>426 Acute biventricular failure</td>
<td>426 Acute biventricular failure</td>
<td>426 Acute biventricular failure</td>
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<tr>
<td>Sec dx</td>
<td>4011 Biplane aortic valve</td>
<td>4011 Biplane aortic valve</td>
<td>4011 Biplane aortic valve</td>
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<td>4280 Congestive heart failure</td>
<td>4280 Congestive heart failure</td>
<td>4280 Congestive heart failure</td>
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<td>42854 Teflons</td>
<td>42854 Teflons</td>
<td>5549 Acute renal failure</td>
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<tr>
<td>Procedure</td>
<td>3778 Insertion of temporary pacemaker</td>
<td>3778 Insertion of temporary pacemaker</td>
<td>3778 Insertion of temporary pacemaker</td>
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<td>CMS DRG</td>
<td>015 Nonspecific CVR &amp; Proximal aortic occlusion w/o infract</td>
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<td>APR categories</td>
<td>046 Nonspecific CVR &amp; Proximal aortic occlusion w/o infract</td>
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<td>SCI</td>
<td>1 (minor)</td>
<td>2 (mod)</td>
<td>3 (major)</td>
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<td>APRR</td>
<td>0.5456</td>
<td>0.8808</td>
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</table>
Cautions

- APR DRG Subclasses (Severity of Illness and Risk of Mortality) are ranked categories unique to each APR DRG and cannot be averaged (they are not really numbers)
  - But in version 20.0 you can average the Relative Weights.
- Beware choosing a population by federal DRG and running reports/analysis by APR DRG Severity of Illness or Risk of Mortality

Inclusion Criteria:
- Age > 17
- ICD-9 480.0  Pneumonia due to adenovirus
- ICD-9 480.1  Pneumonia due to respiratory syncytial virus
- ICD-9 480.2  Pneumonia due to parainfluenza virus
- ICD-9 480.8  Pneumonia due to other virus not elsewhere classified
- ICD-9 480.9  Viral pneumonia, unspecified
- ICD-9 481   Pneumococcal pneumonia
- ICD-9 482.0  Pneumonia due to Klebsiella pneumonia
- ICD-9 482.1  Pneumonia due to Pseudomonas
- ICD-9 482.2  Pneumonia due to Hemophilus influenzae
- ICD-9 482.30 Pneumonia due to Streptococcus, unspecified
- ICD-9 482.31 Pneumonia due to Streptococcus, Group A
- ICD-9 482.32 Pneumonia due to Streptococcus, Group B
- ICD-9 482.39 Pneumonia due to other Streptococcus
- ICD-9 482.40 Pneumonia due to Staphylococcus, unspecified
- ICD-9 482.41 Pneumonia due to Staphylococcus aureus
- ICD-9 482.49 Other Staphylococcus pneumonia
- ICD-9 482.81 Pneumonia due to Anaerobes
- ICD-9 482.82 Pneumonia due to Escherichia coli (E. coli)
- ICD-9 482.83 Pneumonia due to other gram-negative bacteria
- ICD-9 482.84 Pneumonia due to Legionnaires disease
- ICD-9 482.85 Pneumonia due to other specified bacteria
- ICD-9 482.89 Bacterial pneumonia unspecified
- ICD-9 486  Pneumonia, organism unspecified
**Adult Pneumonia Age >17, ICD-9 480.0 - 482.9, and 486 [CDBR:101]**

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<tr>
<th>APR DRG</th>
<th>4</th>
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Respiratory System Diagnosis with Ventilator Support

**Adult Pneumonia Age >17, ICD-9 480.0 - 482.9, and 486 [CDBR:101]**

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APR DRG 139: Other pneumonia
3M™ APR™ DRG Classification System and the State of Maryland

The Maryland Health Services Cost Review Commission (HSCRC) has selected the proprietary 3M APR DRG Classification System to implement as the State of Maryland's classification system for determining payment of hospital acute care services. Maryland hospitals will be paid by all payers, including Medicare, Medicaid, and third-party insurers, according to a new payment model that uses the 3M APR DRG Classification System to classify patients and determine payment rates.

Be sure to return to this web page for the most current information. To ensure that you are receiving the latest and most accurate information about Maryland and the 3M APR DRG Classification System, as well as 3M APR™ DRG Software, be sure to register so you can be alerted when news comes out or newer information is posted to this page.
A second step, currently scheduled for FY 2008, would replace the current 526 DRGs with either

- the proposed 861 consolidated severity-adjusted DRGs or
- an alternative severity adjusted DRG system developed in response to the public comments CMS is soliciting on this issue.

CMS is also considering ways of improving recognition of severity in the current DRG system by FY 2007.

When the two steps are fully implemented, hospitals can expect more accurate payment for their services.

1. New — that is, less than two to three years old
2. Emergency — that is, it must meet a defined cost threshold in relation to the underlying DRG, and
3. A substantial clinical improvement for the Medicare patient population.