



The Fourth Annual  
HealthGrades  
Hospital Quality and Clinical  
Excellence Study

February 2006



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HEALTHGRADES

## HealthGrades Fourth Annual Hospital Quality and Clinical Excellence Study February 2006

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### *Executive Summary*

For the fourth year in a row, HealthGrades researched the overall quality at each of the nation's more than 5,000 nonfederal hospitals. This study identifies hospitals that place in the top five percent in the nation in terms of risk-adjusted mortality and complication rates across a wide range of procedures and diagnoses, indicating institutional success in achieving high-quality outcomes. The study also investigates and quantifies the differences between hospitals in the top five percent and all others.

HealthGrades analysis is based on nearly 39 million Medicare hospital discharges in the years 2002, 2003 and 2004. We identify the top U.S. hospitals based on overall performance of risk-adjusted outcomes associated with the 26 common Medicare inpatient procedures and diagnoses. Of the 5,122 short-term, non-federal, acute care hospitals, only 277 hospitals ranked in the top five percent in the nation. These hospitals are designated as Distinguished Hospitals for Clinical Excellence™.

The Distinguished Hospitals for Clinical Excellence are then compared to all other U.S. hospitals to identify trends in outcomes, relative risk and improvement over the years 2002, 2003 and 2004.

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### *Summary of Findings*

Key findings from this study include:

- 1 Distinguished Hospitals for Clinical Excellence outperformed all other hospitals across all procedures and diagnoses studied during 2002-2004.**
  - On average, **27 percent lower risk of mortality** and **36 percent more improvement** in in-hospital mortality associated with Cardiac Surgery, Angioplasty and Stent, Heart Attack and Heart Failure, Atrial Fibrillation, Chronic Obstructive Pulmonary Disease, Community Acquired Pneumonia, Stroke, Abdominal Aortic Aneurysm Repair, Bowel Obstruction, GI Bleed, Pancreatitis, Diabetic Acidosis and Coma, Pulmonary Embolism and Sepsis.
  - On average, **14 percent lower risk of complications** and **40 percent more improvement** in in-hospital post-operative complications associated with Orthopedic and Neurosurgery, Vascular Surgery, Prostate Surgery and Gall Bladder Surgery.

- 2 If all patients with any of the 26 conditions studied were treated at Distinguished Hospitals during 2002 to 2004, 152,966 lives may have been saved and 21,896 patients may have avoided a major post-operative complication.**
  
- 3 Distinguished Hospitals for Clinical Excellence demonstrated significantly lower in-hospital risk-adjusted mortality rates compared to other hospitals.**
  - The top five areas associated with the greatest risk reduction were noted in:
    - Diabetic Acidosis & Coma – approximately 35% lower
    - Pancreatitis – approximately 32% lower
    - Community Acquired Pneumonia – approximately 31% lower
    - Heart Failure – approximately 29% lower
    - Coronary Artery Bypass Surgery – approximately 29% lower
  
- 4 Distinguished Hospitals for Clinical Excellence demonstrated significantly lower in-hospital risk-adjusted post-operative complication rates compared to other hospitals.**
  - Three of the five areas associated with the greatest risk reduction were noted in orthopedics:
    - Hip Fracture Repair-approximately 18% lower
    - Total Knee Replacement-approximately 16.5% lower
    - Total Hip Replacement-approximately 16% lower

## **Introduction**

With the explosion of consumer directed health plans (CDHP) and predictions of the CDHP market to grow from \$6.4 billion in 2004 to \$289.5 billion in 2009 (Forrester Research), quality information is quickly becoming center-stage for consumers. As they bear higher out-of-pocket expenses, consumers are also demanding more information to assist them in making the most informed healthcare decisions. Although transparency and availability of hospital outcomes are increasing, consumers are still challenged to identify the best hospitals across the nation where they and their families can receive the best medical care.

Each year, HealthGrades takes on this very challenge by developing quality ratings on more than 5,000 U.S. hospitals across 29 procedures and diagnoses and publishing these free ratings on its website, [www.healthgrades.com](http://www.healthgrades.com). Over 2.5 million users visit the HealthGrades site each month. In addition to assessing each of the nation's hospital's quality annually, HealthGrades researches and identifies the top five percent of hospitals in the U.S., based on risk-adjusted complication and mortality rates across 26 diagnoses and procedures (does not include appendectomy, respiratory failure or GI procedures and surgery ratings). This elite group of hospitals is designated as Distinguished Hospitals for Clinical Excellence. This year, HealthGrades analyzed approximately 39 million Medicare hospital discharges.

HealthGrades assigns quality ratings to hospitals according to their actual mortality and complication outcomes, compared to what would be expected to occur at each facility given their respective patient population, for each of 26 procedures and diagnoses. Hospitals that perform in the top five percent nationally for overall outcomes across the 26 medical procedures and diagnoses as rated by HealthGrades are then designated as recipients of the annual Distinguished Hospital Award for Clinical Excellence™ (DHA-CE). See Exhibit A or [www.healthgrades.com](http://www.healthgrades.com) for full list of the 277 2006 recipients.

This study assesses and compares quality outcomes and trends of Distinguished Hospitals for Clinical Excellence (DH-CE) to all other U.S. hospitals across 26 of the most common surgical procedures and medical diagnoses among Medicare beneficiaries 65 years and older during the years 2002, 2003 and 2004.

## Methodology

In order to evaluate overall hospital performance and to identify the best performing hospitals in clinical excellence across the U.S., HealthGrades uses a two-step methodology process:

- Mortality and Complication Based Outcomes Methodology
- Distinguished Hospital Award – Clinical Excellence Methodology

This study concentrates on the 26 of 27 cohorts (appendectomy not included in the DH-CE study) for which HealthGrades has developed a predictive logistic regression model. Appendectomy, which is based on all payer data, was not analyzed in this study. Two additional cohorts not included in the DH-CE study are rated using the APR-DRG methodology (GI Procedures and Surgery, Respiratory Failure). The 26 cohorts in the DH-CE study are as follows.

- Atrial Fibrillation
- Back and Neck Surgery (Spinal Fusion)
- Back and Neck Surgery (except Spinal Fusion)
- Bowel Obstruction
- Carotid Endarterectomy
- Cholecystectomy
- Chronic Obstructive Pulmonary Disease (COPD)
- Community Acquired Pneumonia
- Coronary Bypass Surgery
- Coronary Interventional Procedures
- Diabetic Acidosis and Coma
- Gastrointestinal Bleed
- Heart Attack
- Heart Failure
- Hip Fracture Repair
- Pancreatitis
- Partial Hip Replacement
- Peripheral Vascular Bypass
- Prostatectomy
- Pulmonary Embolism
- Resection / Replacement of Abdominal Aorta
- Sepsis
- Stroke
- Total Hip Replacement
- Total Knee Replacement
- Valve Replacement Surgery

## Mortality and Complication Based Outcomes 2006 Methodology

To help consumers evaluate and compare hospital performance, HealthGrades analyzes patient outcome data for virtually every hospital in the country. HealthGrades purchases the initial data from the Centers for Medicare and Medicaid Services (CMS). The Medicare data (MedPAR file) from CMS contained the inpatient records for Medicare patients.

Ratings are based upon two different risk-adjustment methodologies.

- For 27 medical issues, the risk adjustment is based upon the HealthGrades methodology described in the Multivariate Logistic Regression-Based Ratings section of this white paper.
- For Respiratory Failure and for Gastrointestinal Procedures and Surgeries, the risk adjustment is based upon APR-DRG methodology developed by 3M™ Corporation. APR-DRG stands for All Patient Refined Diagnosis Related Group. (All copyrights in and to APR-DRGs are owned by 3M™.)

All rights reserved.) This methodology is described in the APR-DRG-Based Ratings section of this white paper.

The purpose of risk adjustment is to obtain fair statistical comparisons between disparate populations or groups. Significant differences in demographic and clinical risk factors are found among patients treated in different hospitals. Risk adjustment of the data is needed to make accurate and valid comparisons of clinical outcomes at different hospitals.

Visit [www.HealthGrades.com](http://www.HealthGrades.com) to view hospital ratings and to read the complete methodology white paper *Hospital Report Card™ Mortality and Complication Based Outcomes 2006 Methodology White Paper* (or see in Exhibit D).

## **Distinguished Hospital Award – Clinical Excellence™ 2006 Methodology**

Hospitals are segregated into two groups – teaching and non-teaching. Non-teaching hospitals are further segmented by size with community hospitals being non-teaching hospitals with fewer than 200 beds.

To be considered for the Distinguished Hospital Award for Clinical Excellence (DHA-CE), a hospital had to have had in-hospital mortality or complication ratings in at least 21 of the 28 HealthGrades ratings using MedPAR\* data.

MedPAR data comes from the Centers for Medicare and Medicaid Services (CMS). HealthGrades uses their claims data file, which contains inpatient records for Medicare patients. For more information on how HealthGrades uses this data for ratings, see the HealthGrades *Hospital Report Card™ – Mortality and Complication Based Outcomes 2006 Methodology White Paper* (Exhibit D).

After creating a list of hospitals that met the above criteria, HealthGrades takes the following steps to determine the DHA-CE recipients.

- 1 Calculates the average star rating for each hospital by averaging all their MedPAR-based ratings.
- 2 Ranks hospitals in descending order by their average star rating within the two groups—teaching and non-teaching.
- 3 Selects the top 20 percent of hospitals from each group.
- 4 Excludes hospitals whose average star was less than 3.30.
- 5 Designates the hospitals that remained on the list as the 2006 DHA-CE recipients.

## **Comparison of Distinguished Hospitals for Clinical Excellence Hospitals to All Other Hospitals**

Another purpose of the second part of the study is to evaluate the variation in in-hospital mortality across 26 diagnoses and procedures. In Part I, the actual (observed) and predicted (expected) mortality rates are calculated for each of the 26 procedures and diagnoses for each hospital. The in-hospital observed and expected rates of all patients from Distinguished Hospitals for Clinical Excellence (DH-CE) - those in the top five percent - and all other hospital groups are aggregated for each of the 26 procedures and diagnoses to obtain a DH-CE and all other hospital observed and expected in-hospital mortality rate by procedure and diagnosis.

Unadjusted (observed) mortality rates and numbers are evaluated for trends. Because sicker patients will have higher associated observed mortality, we also calculate and compare observed (O) to expected (E) ratios by procedure or diagnosis and by year for each star rating.

- An O/E ratio of less than 1 means that the procedure/diagnoses measured had fewer deaths than expected given its patient population.
- An O/E of greater than 1 means that the procedure/diagnoses measured had more deaths than expected given its patient population.

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## Results

Distinguished Hospitals for Clinical Excellence (DH-CE) consistently demonstrated significantly lower risk-adjusted in-hospital mortality compared to all other hospitals the years 2002, 2003 and 2004. During the three years studied, DH-CE performed, on average, **27 percent** better than all other hospitals in in-hospital risk-adjusted mortality associated with Cardiac Surgery, Angioplasty and Stent, Heart Attack and Heart Failure, Atrial Fibrillation, Chronic Obstructive Pulmonary Disease, Community Acquired Pneumonia, Stroke, Abdominal Aortic Aneurysm Repair, Bowel Obstruction, GI Bleed, Pancreatitis, Diabetic Acidosis and Coma, Pulmonary Embolism and Sepsis. For details, see Exhibit B.

### On Average, DH-CE had 31 Percent Lower Risk-Adjusted In-hospital Mortality

When comparing DH-CE to all other hospitals, the largest differences in in-hospital risk-adjusted mortality were noted in the following areas.

| Table 1<br>Largest Difference In In-hospital Risk-Adjusted Mortality |     |
|--|-----|
| Diabetic Acidosis & Coma   | 35% |
| Pancreatitis   | 32% |
| Community Acquired Pneumonia   | 31% |
| Heart Failure  | 29% |
| Coronary Artery Bypass Surgery                                       | 29% |

For these five areas associated with the greatest in-hospital mortality differences, DH-CE had, on average, a 31 percent lower risk-adjusted in-hospital. For details, see Exhibit B.

### On Average, DH-CE Performed 14 Percent Better in In-hospital Post-Operative Complications

Similar trends were also noted when evaluating in-hospital risk-adjusted post-operative complications. Distinguished Hospitals for Clinical Excellence (DH-CE) demonstrated lower risk-adjusted in-hospital post-operative complications compared to all other hospitals during 2002-2004. During the three years studied, DH-CE performed, on average, 14 percent better than all other hospitals in in-hospital post-operative complications associated with Orthopedic and Neurosurgery, Vascular Surgery, Prostate Surgery and Gall Bladder Surgery. For details, see Exhibit C.

When comparing DH-CE to all other hospitals, the largest differences in in-hospital risk-adjusted post-operative complications were noted in the following areas.

|                        |       |
|------------------------|-------|
| Hip Fracture Repair    | 18%   |
| Total Knee Replacement | 16.5% |
| Total Hip Replacement  | 16%   |

For these three areas associated with the greatest in-hospital complication differences, DH-CE had, on average, a 17-percent lower risk-adjusted in-hospital post-operative complication rate. For details, see Exhibit C.

#### DH-CE Improved at Greater Rate

Although Distinguished Hospitals for Clinical Excellence had significantly lower in-hospital risk-adjusted mortality and complications for all three years studied, they improved at a greater rate than all other hospitals. DH-CE risk-adjusted in-hospital mortality and complications improved by 16.5 percent and 10.4 percent during 2002-2004, while all other hospitals lagged behind the DH-CE improvement rate by 27 percent and 29 percent, respectively.

Despite these apparent differences in rates of improvement, DH-CE and all other hospitals had the greatest improvements in the same areas: Heart Failure, Atrial Fibrillation, Chronic Obstructive Pulmonary Disease, Community Acquired Pneumonia, Total Knee Replacement, Total Hip Replacement, Carotid Endarterectomy and Peripheral Vascular Bypass. For details, see Exhibit B and C.

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## Interpretation of Results

As a group, Distinguished Hospitals for Clinical Excellence outperformed all other U.S. hospitals across all 26 diagnoses and procedures studied. Among the Medicare beneficiaries admitted to U.S. hospitals during 2002-2004, **152,966 lives may have been saved and 21,896 patients may have avoided a major post-operative complication** if they had been treated at Distinguished Hospitals for Clinical Excellence.

Distinguished Hospitals for Clinical Excellence made a big impact during the three year study period. Not only did they have lower risk-adjusted mortality and complications for all three years studied, but they outpaced all other hospitals by improving their already better than expected outcomes better than all other hospitals. We believe that these hospitals explicitly define quality, set their aims high, commit to continuous improvement and excellence, and share their goals with all stakeholders.

In conclusion, our study identifies an overall quality benchmark that is quite high but demonstrably achievable by an elite group of distinguished hospitals. By identifying these Distinguished Hospitals for Clinical Excellence, HealthGrades is providing an objective measurement of overall quality and identifying the best of the best for all stakeholders, a benchmark that can be used for quality improvement and informed decision-making. Going forward, quality and safety will need to be continuously measured and accessible to patients and purchasers of healthcare. We believe the opportunities for improvement are tremendous, and this study demonstrated that the answers are within reach.



## ***Exhibit A: List of Distinguished Hospitals for Clinical Excellence™***

### **Teaching Distinguished Hospitals for Clinical Excellence\***

| <b>DH-CE Teaching Hospitals</b>              | <b>City</b>    | <b>State</b> |
|--|----------------|--------------|
| Abbott Northwestern Hospital Inc             | Minneapolis    | MN           |
| Advocate Christ Medical Center               | Oak Lawn       | IL           |
| Advocate Lutheran General Hospital           | Park Ridge     | IL           |
| Advocate Ravenswood Medical Center           | Chicago        | IL           |
| Akron General Medical Center                 | Akron          | OH           |
| Aspirus Wausau Hospital                      | Wausau         | WI           |
| Avera Mckennan Hosp & Univ Health Center     | Sioux Falls    | SD           |
| Baylor University Medical Center             | Dallas         | TX           |
| Beth Israel Deaconess Medical Center         | Boston         | MA           |
| Billings Clinic                              | Billings       | MT           |
| Bon Secours Hospital                         | Grosse Pointe  | MI           |
| Caritas Medical Center                       | Louisville     | KY           |
| Cedars Sinai Medical Center                  | Los Angeles    | CA           |
| Charleston Area Medical Center               | Charleston     | WV           |
| Chippenham Johnston Willis Hospital          | Richmond       | VA           |
| Christ Hospital                              | Cincinnati     | OH           |
| Christus Santa Rosa Healthcare               | San Antonio    | TX           |
| Christus Spohn Hospital Corpus Christi       | Corpus Christi | TX           |
| Cleveland Clinic Foundation                  | Cleveland      | OH           |
| Community Health Partners of OH West         | Lorain         | OH           |
| Community Hospital East/ North               | Indianapolis   | IN           |
| Danbury Hospital                             | Danbury        | CT           |
| Doctors Hospital                             | Coral Gables   | FL           |
| Easton Hospital                              | Easton         | PA           |
| Ellis Hospital                               | Schenectady    | NY           |
| Evanston Northwestern Healthcare             | Evanston       | IL           |
| Fairview Hospital                            | Cleveland      | OH           |
| Florida Hospital – Ormond Memorial/Oceanside | Ormond Beach   | FL           |
| Franklin Square Hospital Center              | Baltimore      | MD           |
| Genesys Regional Medical Center              | Grand Blanc    | MI           |
| Glendale Adventist Medical Center            | Glendale       | CA           |

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| DH-CE Teaching Hospitals                       | City             | State |
|--|------------------|-------|
| Good Samaritan Hospital                        | Los Angeles      | CA    |
| Good Samaritan Hospital                        | Baltimore        | MD    |
| Grandview and Southview Hospitals              | Dayton           | OH    |
| Greater Baltimore Medical Center               | Baltimore        | MD    |
| Griffin Hospital                               | Derby            | CT    |
| Hackensack University Medical Center           | Hackensack       | NJ    |
| Hamot Hospital                                 | Erie             | PA    |
| Healtheast St Johns Hospital                   | Maplewood        | MN    |
| Healtheast St Joseph's Hospital                | Saint Paul       | MN    |
| Henry Ford Wyandotte Hospital                  | Wyandotte        | MI    |
| Hillcrest Hospital                             | Mayfield Heights | OH    |
| Hunterdon Medical Center                       | Flemington       | NJ    |
| Inova Fairfax Hospital                         | Falls Church     | VA    |
| Jersey Shore University Medical Center         | Neptune          | NJ    |
| Jewish Hospital                                | Louisville       | KY    |
| Jewish Hospital The                            | Cincinnati       | OH    |
| JFK Medical Center                             | Atlantis         | FL    |
| Kendall Medical Center                         | Miami            | FL    |
| Kettering Medical Center                       | Kettering        | OH    |
| Lahey Clinic                                   | Burlington       | MA    |
| Lancaster General Hospital                     | Lancaster        | PA    |
| Lehigh Valley Hospital                         | Allentown        | PA    |
| Lehigh Valley Hospital Muhlenberg              | Bethlehem        | PA    |
| Little Company of Mary Hospital                | Evergreen Park   | IL    |
| Lutheran Hospital of Indiana                   | Fort Wayne       | IN    |
| Lutheran Medical Center                        | Brooklyn         | NY    |
| Main Line Hospitals Lankenau                   | Wynnewood        | PA    |
| Margaret R Pardee Memorial Hospital            | Hendersonville   | NC    |
| Mayo Clinic Hospital                           | Phoenix          | AZ    |
| Mcallen Heart Hospital/mcallen Medical Center  | Mcallen          | TX    |
| Mclaren Regional Medical Center                | Flint            | MI    |
| Medical Center of Aurora                       | Aurora           | CO    |
| Memorial Healthcare System Inc                 | Chattanooga      | TN    |
| Memorial Hermann Northwest/Southwest/Southeast | Houston          | TX    |
| Mercy General Health Partners                  | Muskegon         | MI    |
| Mercy Hospital and Medical Center              | Chicago          | IL    |
| Mercy Hospital Inc                             | Miami            | FL    |

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| DH-CE Teaching Hospitals                     | City             | State |
|--|------------------|-------|
| Mercy Hospital Scranton                      | Scranton         | PA    |
| Middlesex Hospital                           | Middletown       | CT    |
| MidMichigan Medical Center-Midland           | Midland          | MI    |
| Midwest Regional Medical Center              | Midwest City     | OK    |
| Mission Hospitals                            | Asheville        | NC    |
| Missouri Baptist Medical Center              | St. Louis        | MO    |
| Monmouth Medical Center                      | Long Branch      | NJ    |
| Morton Plant Hospital                        | Clearwater       | FL    |
| Mount Sinai Medical Center                   | Miami Beach      | FL    |
| Mt Carmel Health                             | Columbus         | OH    |
| Munson Medical Center                        | Traverse City    | MI    |
| New York Presbyterian Hospital               | New York         | NY    |
| Newton Wellesley Hospital                    | Newton           | MA    |
| North Memorial Health Care                   | Robbinsdale      | MN    |
| North Shore Medical Center                   | Salem            | MA    |
| Northside Hospital                           | Saint Petersburg | FL    |
| Oakwood Annapolis Hospital                   | Wayne            | MI    |
| Oakwood Hospital and Medical Center Dearborn | Dearborn         | MI    |
| Ohio State University Hospitals East         | Columbus         | OH    |
| Our Lady of The Resurrection Medical Center  | Chicago          | IL    |
| Park Nicollet Health Services                | Saint Louis Park | MN    |
| Pennsylvania Hospital The                    | Philadelphia     | PA    |
| Penrose - St Francis Health Services         | Colorado Springs | CO    |
| Pomona Valley Hospital Medical Center        | Pomona           | CA    |
| Porter Adventist Hospital                    | Denver           | CO    |
| Poudre Valley Hospital                       | Fort Collins     | CO    |
| Providence Hospital and Medical Centers      | Southfield       | MI    |
| Robert Wood Johnson University Hospital      | New Brunswick    | NJ    |
| Rose Medical Center                          | Denver           | CO    |
| Rush North Shore Medical Center              | Skokie           | IL    |
| S S M Depaul Health Center                   | Bridgeton        | MO    |
| Saint Joseph Hospital                        | Chicago          | IL    |
| Scott and White Memorial Hospital            | Temple           | TX    |
| Scottsdale Healthcare Osborn                 | Scottsdale       | AZ    |
| Scottsdale Healthcare Shea                   | Scottsdale       | AZ    |
| Sentara Virginia Beach General Hospital      | Virginia Beach   | VA    |

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| DH-CE Teaching Hospitals                        | City                 | State |
|---|----------------------|-------|
| Shawnee Mission Medical Center                  | Shawnee Mission      | KS    |
| Sibley Memorial Hospital                        | Washington           | DC    |
| Sioux Valley Hospital University Medical Center | Sioux Falls          | SD    |
| South Miami Hospital                            | Miami                | FL    |
| South Pointe Hospital                           | Warrensville Heights | OH    |
| Southern Ohio Medical Center                    | Portsmouth           | OH    |
| Southwest General Health Center                 | Middleburg Heights   | OH    |
| St Alexius Medical Center                       | Hoffman Estates      | IL    |
| St Alexius Medical Center                       | Bismarck             | ND    |
| St Charles Mercy Hospital                       | Oregon               | OH    |
| St Elizabeth Medical Center                     | Edgewood             | KY    |
| St Francis Hospital and Health Center           | Blue Island          | IL    |
| St Francis Hospital and Health Centers          | Beech Grove          | IN    |
| St John West Shore Hospital                     | Westlake             | OH    |
| St Joseph Mercy Oakland                         | Pontiac              | MI    |
| St Joseph's Hospital                            | Marshfield           | WI    |
| St Luke's Episcopal-Presbyterian Hospital       | Chesterfield         | MO    |
| St Lukes Hospital                               | Cedar Rapids         | IA    |
| St Lukes Hospital                               | Bethlehem            | PA    |
| St Mary Medical Center                          | Long Beach           | CA    |
| St Marys Health Center                          | Richmond Heights     | MO    |
| St Marys Hospital                               | Rochester            | MN    |
| St Mary's Medical Center                        | Duluth               | MN    |
| St Mary's Regional Medical Center               | Enid                 | OK    |
| St Thomas Hospital                              | Nashville            | TN    |
| St Vincent Charity Hospital                     | Cleveland            | OH    |
| St Vincent Hospital and Health Services         | Indianapolis         | IN    |
| St Vincent Medical Center                       | Los Angeles          | CA    |
| St Vincent's Medical Center                     | Jacksonville         | FL    |
| St. Alphonsus Regional Medical Center           | Boise                | ID    |
| Summa Health System                             | Akron                | OH    |
| Swedish Covenant Hospital                       | Chicago              | IL    |
| UHHS Bedford Medical Center                     | Bedford              | OH    |
| United Hospital Center                          | Clarksburg           | WV    |
| United Hospitals Inc                            | Saint Paul           | MN    |
| Unity Health System Park Ridge Hospital         | Rochester            | NY    |

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| DH-CE Teaching Hospitals                        | City        | State |
|---|-------------|-------|
| UPMC McKeesport Hospital                        | Mc Keesport | PA    |
| UT Southwestern University Hospital - St Paul   | Dallas      | TX    |
| Virginia Baptist Hospital and Lynchburg General | Lynchburg   | VA    |
| Virginia Hospital Center- Arlington             | Arlington   | VA    |
| Virginia Mason Medical Center                   | Seattle     | WA    |
| Waukesha Memorial Hospital                      | Waukesha    | WI    |
| West Allis Memorial Hspitl                      | West Allis  | WI    |
| William Beaumont Hospital                       | Royal Oak   | MI    |
| William Beaumont Hospital Troy                  | Troy        | MI    |
| Willis-Knighton Medical Center                  | Shreveport  | LA    |
| Winchester Medical Center Inc                   | Winchester  | VA    |
| York Hospital                                   | York        | PA    |

### Non-Teaching Distinguished Hospitals for Clinical Excellence\*

| DH-CE Non-Teaching Hospitals       | City              | State |
|------------------------------------|-------------------|-------|
| Advocate Good Samaritan Hospital   | Downers Grove     | IL    |
| Alexian Brothers Medical Center    | Elk Grove Village | IL    |
| Alle Kiski Medical Center          | Natrona Heights   | PA    |
| Baptist Hospital East              | Louisville        | KY    |
| Baptist Hospital of Miami Inc      | Miami             | FL    |
| Bay Medical Center                 | Panama City       | FL    |
| Bayshore Medical Center            | Pasadena          | TX    |
| Benefis Healthcare                 | Great Falls       | MT    |
| Bethesda Memorial Hospital         | Boynton Beach     | FL    |
| Blake Medical Center               | Bradenton         | FL    |
| Boca Raton Community Hospital Inc  | Boca Raton        | FL    |
| Brandon Regional Hospital          | Brandon           | FL    |
| Brotman Medical Center             | Culver City       | CA    |
| Central Florida Regional Hospital  | Sanford           | FL    |
| Centrastate Medical Center         | Freehold          | NJ    |
| Chesapeake General Hospital        | Chesapeake        | VA    |
| Clear Lake Regional Medical Center | Webster           | TX    |
| Community Hospital The             | Munster           | IN    |
| Community Medical Center           | Toms River        | NJ    |
| Deaconess Hospital                 | Cincinnati        | OH    |
| Delray Medical Center              | Delray Beach      | FL    |

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| DH-CE Non-Teaching Hospitals                               | City               | State |
|--|--------------------|-------|
| E M H Regional Medical Center                              | Elyria             | OH    |
| Edward Hospital  | Naperville         | IL    |
| El Camino Hospital   | Mountain View      | CA    |
| Elmhurst Memorial Hospital                                 | Elmhurst           | IL    |
| Exempla Lutheran Medical Center                            | Wheat Ridge        | CO    |
| Fairview Southdale Hospital                                | Edina              | MN    |
| Fawcett Memorial Hospital                                  | Port Charlotte     | FL    |
| Flagler Hospital   | Saint Augustine    | FL    |
| Florida Medical Center                                     | Lauderdale Lakes   | FL    |
| Glendale Memorial Hospital and Health Center               | Glendale           | CA    |
| Good Shepherd Medical Center                               | Longview           | TX    |
| Gwinnett Hospital System                                   | Lawrenceville      | GA    |
| Heartland Regional Medical Center                          | Saint Joseph       | MO    |
| Henrico Doctors Hospital Forest Campus/ Parham Campus      | Richmond           | VA    |
| Hoag Memorial Hospital Presbyterian                        | Newport Beach      | CA    |
| Holmes Regional Medical Center/Palm Bay Community Hospital | Melbourne          | FL    |
| Holy Cross Hospital  | Fort Lauderdale    | FL    |
| Holy Name Hospital   | Teaneck            | NJ    |
| Lake Hospital System Inc                                   | Painesville        | OH    |
| Laredo Medical Center                                      | Laredo             | TX    |
| Lawnwood Regional Medical Center & Heart Institute         | Fort Pierce        | FL    |
| Lewis-Gale Medical Center                                  | Salem              | VA    |
| Martin Memorial Medical Center                             | Stuart             | FL    |
| Marymount Hospital   | Garfield Heights   | OH    |
| Mercy Medical Center of Springfield                        | Springfield        | OH    |
| Methodist Hospital of Southern California                  | Arcadia            | CA    |
| Munroe Regional Medical Center                             | Ocala              | FL    |
| Naples Community Hospital                                  | Naples             | FL    |
| Northern Westchester Hospital                              | Mount Kisco        | NY    |
| Northwest Community Hospital                               | Arlington Heights  | IL    |
| Northwest Hospital Center                                  | Randallstown       | MD    |
| Ocala Regional Medical Center                              | Ocala              | FL    |
| Palm Beach Gardens Medical Center                          | Palm Beach Gardens | FL    |
| Palos Community Hospital                                   | Palos Heights      | IL    |

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| DH-CE Non-Teaching Hospitals           | City             | State |
|--|------------------|-------|
| Parma Community General Hospital       | Parma            | OH    |
| Regional Medical Center Bayonet Point  | Hudson           | FL    |
| Rex Hospital                           | Raleigh          | NC    |
| Rio Grande Regional Hospital           | Mcallen          | TX    |
| Rockingham Memorial Hospital           | Harrisonburg     | VA    |
| RWJ University Hospital at Hamilton    | Hamilton         | NJ    |
| Saint John's Health System             | Anderson         | IN    |
| Saint Josephs Hospital of Atlanta      | Atlanta          | GA    |
| Sarasota Memorial Hospital             | Sarasota         | FL    |
| Sequoia Hospital                       | Redwood City     | CA    |
| Seton Medical Center                   | Austin           | TX    |
| Sherman Hospital                       | Elgin            | IL    |
| South Shore Hospital                   | South Weymouth   | MA    |
| St Francis Medical Center              | Monroe           | LA    |
| St Johns Hospital Health Center        | Santa Monica     | CA    |
| St Johns Regional Medical Center       | Oxnard           | CA    |
| St Joseph's Hospital                   | Tampa            | FL    |
| St Josephs Mercy of Macomb             | Clinton Township | MI    |
| St Mary's Medical Center Inc           | Knoxville        | TN    |
| St. Mary Mercy Hospital                | Livonia          | MI    |
| University Hospital and Medical Center | Tamarac          | FL    |
| Washington Hospital                    | Fremont          | CA    |
| Westside Regional Medical Center       | Plantation       | FL    |
| White Plains Hospital Center           | White Plains     | NY    |

### Community Distinguished Hospitals for Clinical Excellence\*

| DH-CE Community Hospitals                | City            | State |
|--|-----------------|-------|
| Advocate South Suburban Hospital         | Hazel Crest     | IL    |
| Augusta Medical Center                   | Fishersville    | VA    |
| Bay Area Medical Center                  | Marinette       | WI    |
| Cape Canaveral Hospital                  | Cocoa Beach     | FL    |
| Charlotte Regional Medical Center        | Punta Gorda     | FL    |
| Cleveland Clinic Florida Hospital Naples | Naples          | FL    |
| Crittenton Hospital Medical Center       | Rochester Hills | MI    |
| Del E Webb Memorial Hospital             | Sun City West   | AZ    |
| Doctor's Community Hospital              | Lanham          | MD    |
| Englewood Community Hospital             | Englewood       | FL    |

\* Cannot be used without a Licensing Agreement from Health Grades, Inc.

| DH-CE Community Hospitals                         | City             | State |
|---|------------------|-------|
| Ephrata Community Hospital                        | Ephrata          | PA    |
| Florida Hospital Fish Memorial                    | Orange City      | FL    |
| Florida Hospital Heartland Division               | Sebring          | FL    |
| Garfield Medical Center                           | Monterey Park    | CA    |
| Glenwood Regional Medical Center                  | West Monroe      | LA    |
| Hackley Hospital                                  | Muskegon         | MI    |
| Hays Medical Center                               | Hays             | KS    |
| Helen Ellis Memorial Hospital                     | Tarpon Springs   | FL    |
| Jupiter Medical Center                            | Jupiter          | FL    |
| Lakewood Hospital                                 | Lakewood         | OH    |
| Los Robles Regional Medical Center                | Thousand Oaks    | CA    |
| Mease Countryside Hospital                        | Clearwater       | FL    |
| Mease Dunedin Hospital                            | Dunedin          | FL    |
| Memorial Medical Center                           | Woodstock        | IL    |
| Mercy Medical Center                              | Roseburg         | OR    |
| Mercy Medical Center Clinton                      | Clinton          | IA    |
| Meridia Euclid Hospital                           | Euclid           | OH    |
| Oak Hill Hospital                                 | Brooksville      | FL    |
| Peace River Regional Medical Center               | Port Charlotte   | FL    |
| Port Huron Hospital                               | Port Huron       | MI    |
| Providence Holy Cross Medical Center              | Mission Hills    | CA    |
| San Leandro Hospital                              | San Leandro      | CA    |
| Scripps Memorial Hospital Encinitas               | Encinitas        | CA    |
| Skaggs Community Health Center                    | Branson          | MO    |
| Skyline Medical Center                            | Nashville        | TN    |
| South Bay Hospital                                | Sun City Center  | FL    |
| SSM St Joseph Health Center                       | Saint Charles    | MO    |
| St Catherine Hospital                             | East Chicago     | IN    |
| St Lucie Medical Center                           | Port Saint Lucie | FL    |
| St Luke's Cornwall Hospital Newburgh And Cornwall | Newburgh         | NY    |
| Union Hospital of Cecil County                    | Elkton           | MD    |
| UPMC Lee Regional                                 | Johnstown        | PA    |
| Valley Regional Medical Center                    | Brownsville      | TX    |
| William W Backus Hospital                         | Norwich          | CT    |
| Willis Knighton Bossier Health Center             | Bossier City     | LA    |
| Woodland Heights Medical Center                   | Lufkin           | TX    |

\* Cannot be used without a Licensing Agreement from Health Grades, Inc.



## Exhibit B: Inhospital Mortality Performance

### Distinguished Hospitals for Clinical Excellence (DH-CE) Compared to All Other U.S. Hospitals (3-Year Aggregate Risk-Adjusted Inhospital Mortality Performance: 2002-2004)

| Diagnosis or Procedure                                 | Year      | Total Number of All U.S. Medicare Hospitalizations | Total Number of U.S. Medicare DH-CE Hospitalizations | DH-CE Hospitals Average Observed Inhospital Mortality to Expected Inhospital Mortality Ratio <sup>1</sup> | % Improvement by DH-CE Hospitals | All Other U.S. Hospitals Average Observed Inhospital Mortality to Expected Inhospital Mortality Ratio <sup>2</sup> | % Improvement by All Other Hospitals | Relative Risk Reduction Associated with DH-CE Hospitals Compared to All Other U.S. Hospitals | Number of Lives That Could Have Been Saved If All Patients Treated at DH-CE Hospitals (2002-2004) <sup>3</sup> |
|--|-----------|--|--|---|----------------------------------|--|--------------------------------------|--|--|
| Coronary Artery Bypass Surgery                         | 2002      |  |  | 0.83  |                                  | 1.14   |                                      |  |  |
|  | 2003      |  |  | 0.74  |                                  | 1.06   |                                      |  |  |
|  | 2004      |  |  | 0.72  |                                  | 1.01   |                                      |  |  |
|  | 2002-2004 | 357,189  | 80,843   | 0.77  | 13.78%                           | 1.07   | 11.33%                               | 28.58%   | 2,690  |
| Valve Replacement Surgery                              | 2002      |  |  | 0.81  |                                  | 1.09   |                                      |  |  |
|  | 2003      |  |  | 0.83  |                                  | 1.05   |                                      |  |  |
|  | 2004      |  |  | 0.73  |                                  | 0.97   |                                      |  |  |
|  | 2002-2004 | 109,472  | 28,275   | 0.79  | 9.72%                            | 1.06   | 10.74%                               | 25.59%   | 1,742  |
| Coronary Interventional Procedures (Angioplasty/Stent) | 2002      |  |  | 0.86  |                                  | 1.04   |                                      |  |  |
|  | 2003      |  |  | 0.79  |                                  | 1.02   |                                      |  |  |
|  | 2004      |  |  | 0.82  |                                  | 1.08   |                                      |  |  |
|  | 2002-2004 | 960,642  | 220,588  | 0.83  | 4.09%                            | 1.05   | -3.47%                               | 21.66%   | 3,117  |
| Heart Attack   | 2002      |  |  | 0.90  |                                  | 1.08   |                                      |  |  |
|  | 2003      |  |  | 0.83  |                                  | 1.02   |                                      |  |  |
|  | 2004      |  |  | 0.81  |                                  | 1.02   |                                      |  |  |
|  | 2002-2004 | 888,528  | 174,312  | 0.84  | 9.62%                            | 1.04   | 5.44%                                | 18.47%   | 17,170   |

| Diagnosis or Procedure                       | Year      | Total Number of All U.S. Medicare Hospitalizations | Total Number of U.S. Medicare DH-CE Hospitalizations | DH-CE Hospitals Average Observed Inhospital Mortality to Expected Inhospital Mortality Ratio <sup>1</sup> | % Improvement by DH-CE Hospitals | All Other U.S. Hospitals Average Observed Inhospital Mortality to Expected Inhospital Mortality Ratio <sup>2</sup> | % Improvement by All Other Hospitals | Relative Risk Reduction Associated with DH-CE Hospitals Compared to All Other U.S. Hospitals | Number of Lives That Could Have Been Saved If All Patients Treated at DH-CE Hospitals (2002-2004) <sup>3</sup> |
|--|-----------|--|--|---|----------------------------------|--|--------------------------------------|--|--|
| Heart Failure                                | 2002      |  |  | 0.86  |                                  | 1.16   |                                      |  |  |
|  | 2003      |  |  | 0.73  |                                  | 1.05   |                                      |  |  |
|  | 2004      |  |  | 0.67  |                                  | 0.97   |                                      |  |  |
|  | 2002-2004 | 2,000,361  | 325,649  | 0.75  | 21.44%                           | 1.05   | 16.60%                               | 29.15%   | 24,357   |
| Atrial Fibrillation                          | 2002      |  |  | 0.85  |                                  | 1.18   |                                      |  |  |
|  | 2003      |  |  | 0.81  |                                  | 1.08   |                                      |  |  |
|  | 2004      |  |  | 0.67  |                                  | 0.97   |                                      |  |  |
|  | 2002-2004 | 550,193  | 101,277  | 0.78  | 21.10%                           | 1.06   | 17.88%                               | 26.48%   | 1,928  |
| Chronic Obstructive Pulmonary Disease (COPD) | 2002      |  |  | 0.86  |                                  | 1.15   |                                      |  |  |
|  | 2003      |  |  | 0.73  |                                  | 1.03   |                                      |  |  |
|  | 2004      |  |  | 0.67  |                                  | 0.96   |                                      |  |  |
|  | 2002-2004 | 1,059,385  | 147,141  | 0.75  | 21.98%                           | 1.05   | 16.63%                               | 27.98%   | 7,390  |
| Community Acquired Pneumonia                 | 2002      |  |  | 0.80  |                                  | 1.14   |                                      |  |  |
|  | 2003      |  |  | 0.72  |                                  | 1.04   |                                      |  |  |
|  | 2004      |  |  | 0.65  |                                  | 0.96   |                                      |  |  |
|  | 2002-2004 | 1,669,399  | 217,591  | 0.72  | 19.47%                           | 1.05   | 15.64%                               | 30.92%   | 32,349   |
| Stroke                                       | 2002      |  |  | 0.85  |                                  | 1.10   |                                      |  |  |
|  | 2003      |  |  | 0.78  |                                  | 1.02   |                                      |  |  |
|  | 2004      |  |  | 0.76  |                                  | 0.98   |                                      |  |  |
|  | 2002-2004 | 821,975  | 139,630  | 0.80  | 10.03%                           | 1.04   | 10.60%                               | 23.66%   | 19,493   |
| Resection/Replacement of Abdominal Aorta     | 2002      |  |  | 0.73  |                                  | 1.06   |                                      |  |  |
|  | 2003      |  |  | 0.77  |                                  | 1.00   |                                      |  |  |
|  | 2004      |  |  | 0.83  |                                  | 0.82   |                                      |  |  |
|  | 2002-2004 | 37,182   | 8,615  | 0.79  | -13.03%                          | 0.96   | 22.11%                               | 17.45%   | 337  |

| Diagnosis or Procedure                         | Year      | Total Number of All U.S. Medicare Hospitalizations | Total Number of U.S. Medicare DH-CE Hospitalizations | DH-CE Hospitals Average Observed Inhospital Mortality to Expected Inhospital Mortality Ratio <sup>1</sup> | % Improvement by DH-CE Hospitals | All Other U.S. Hospitals Average Observed Inhospital Mortality to Expected Inhospital Mortality Ratio <sup>2</sup> | % Improvement by All Other Hospitals | Relative Risk Reduction Associated with DH-CE Hospitals Compared to All Other U.S. Hospitals | Number of Lives That Could Have Been Saved If All Patients Treated at DH-CE Hospitals (2002-2004) <sup>3</sup> |
|--|-----------|--|--|---|----------------------------------|--|--------------------------------------|--|--|
| Bowel Obstruction                              | 2002      |  |  | 0.87  |                                  | 1.12   |                                      |  |  |
|  | 2003      |  |  | 0.78  |                                  | 1.04   |                                      |  |  |
|  | 2004      |  |  | 0.72  |                                  | 0.97   |                                      |  |  |
|  | 2002-2004 | 511,059  | 86,734   | 0.79  | 16.30%                           | 1.05   | 13.87%                               | 24.44%   | 6,838  |
| Gastrointestinal Bleed                         | 2002      |  |  | 0.88  |                                  | 1.16   |                                      |  |  |
|  | 2003      |  |  | 0.75  |                                  | 1.05   |                                      |  |  |
|  | 2004      |  |  | 0.70  |                                  | 0.96   |                                      |  |  |
|  | 2002-2004 | 126,417  | 126,417  | 0.77  | 19.81%                           | 1.05   | 17.07%                               | 26.54%   | 6,008  |
| Pancreatitis                                   | 2002      |  |  | 0.89  |                                  | 1.15   |                                      |  |  |
|  | 2003      |  |  | 0.69  |                                  | 1.02   |                                      |  |  |
|  | 2004      |  |  | 0.63  |                                  | 0.91   |                                      |  |  |
|  | 2002-2004 | 134,206  | 25,352   | 0.72  | 29.56%                           | 1.06   | 20.49%                               | 31.98%   | 1,393  |
| Diabetic Acidosis and Coma                     | 2002      |  |  | 0.89  |                                  | 1.15   |                                      |  |  |
|  | 2003      |  |  | 0.60  |                                  | 1.09   |                                      |  |  |
|  | 2004      |  |  | 0.53  |                                  | 0.93   |                                      |  |  |
|  | 2002-2004 | 258,895  | 36,620   | 0.68  | 39.98%                           | 1.05   | 18.98%                               | 35.17%   |  |
| Pulmonary Embolism                             | 2002      |  |  | 0.86  |                                  | 1.09   |                                      |  |  |
|  | 2003      |  |  | 0.79  |                                  | 0.99   |                                      |  |  |
|  | 2004      |  |  | 0.68  |                                  | 0.93   |                                      |  |  |
|  | 2002-2004 | 113,221  | 25,338   | 0.77  | 20.94%                           | 1.01   | 15.21%                               | 24.37%   | 1,478  |
| Sepsis   | 2002      |  |  | 0.83  |                                  | 1.06   |                                      |  |  |
|  | 2003      |  |  | 0.75  |                                  | 1.00   |                                      |  |  |
|  | 2004      |  |  | 0.77  |                                  | 1.04   |                                      |  |  |
|  | 2002-2004 | 561,022  | 103,031  | 0.78  | 6.92%                            | 1.05   | 2.67%                                | 25.57%   | 26,677   |
| <b>Totals</b>                                  |           | <b>10,159,146</b>                                  | <b>1,847,413</b>                                     | <b>-</b>  | <b>-</b>                         | <b>-</b>   | <b>-</b>                             | <b>-</b>   | <b>152,966</b>   |
| <b>3 Year Performance Averages<sup>4</sup></b> |           | <b>-</b>   | <b>-</b>   | <b>0.77</b>   | <b>16.53%</b>                    | <b>1.05</b>  | <b>12.12%</b>                        | <b>26.66%</b>  | <b>-</b>   |

- <sup>1</sup> All individual years and 3 year aggregate outcomes were statistically significantly better than expected ( $p < 0.05$ ) for DH-CE hospitals
- <sup>2</sup> All individual years and 3 year aggregate outcomes were statistically significantly worse than expected ( $p < 0.05$ ) for All Other hospitals except for Resection/Replacement of Abdominal Aorta and Pulmonary Embolism which were not statistically significant different from expected
- <sup>3</sup> Lives saved was calculated (data not shown): All Other hospitals' 3 year actual number of mortalities - (All Other hospitals' 3 year expected number of mortalities x DH-CE O/E ratio)
- <sup>4</sup> All averages are weighted averages

**Exhibit C: Hospitals for Clinical Excellence (DH-CE) Compared to All Other U.S. Hospitals (3 Year Aggregate Risk-Adjusted Inhospital Post-operative Complications Performance: 2002-2004)**

| Diagnosis or Procedure                        | Year      | Total Number of U.S. Medicare Hospitalizations | Total Number of U.S. Medicare DH-CE Hospitalizations | DH-CE Hospitals Average Observed Inhospital Complications to Expected Inhospital Complications Ratio <sup>1</sup> | % Improvement by DH-CE Hospitals | All Other U.S. Hospitals Average Observed Inhospital Complications to Expected Inhospital Complications Ratio <sup>2</sup> | % Improvement by All Other Hospitals | Relative Risk Reduction Associated with DH-CE Hospitals Compared to All Other U.S. Hospitals | Number of Patients That Could Have Been Avoided Developing ≥1 Post-Op Complications If All Patients Treated at DH-CE Hospitals (2002-2004) <sup>3</sup> |
|---|-----------|--|--|---|----------------------------------|--|--------------------------------------|--|---|
| Total Knee Replacement                        | 2002      |  |  | 0.94  |                                  | 1.10   |                                      |  |   |
|   | 2003      |  |  | 0.88  |                                  | 1.06   |                                      |  |   |
|   | 2004      |  |  | 0.77  |                                  | 0.96   |                                      |  |   |
|   | 2002-2004 | 569,213  | 106,562  | 0.86  | 17.68%                           | 1.03   | 13.13%                               | 16.43%   | 3,308   |
| Total Hip Replacement                         | 2002      |  |  | 0.91  |                                  | 1.10   |                                      |  |   |
|   | 2003      |  |  | 0.89  |                                  | 1.05   |                                      |  |   |
|   | 2004      |  |  | 0.78  |                                  | 0.96   |                                      |  |   |
|   | 2002-2004 | 262,929  | 54,498   | 0.85  | 13.93%                           | 1.01   | 12.89%                               | 15.79%   | 1,906   |
| Hip Fracture Repair                           | 2002      |  |  | 0.89  |                                  | 1.05   |                                      |  |   |
|   | 2003      |  |  | 0.84  |                                  | 1.04   |                                      |  |   |
|   | 2004      |  |  | 0.80  |                                  | 1.00   |                                      |  |   |
|   | 2002-2004 | 377,848  | 63,023   | 0.85  | 10.00%                           | 1.03   | 4.13%                                | 17.70%   | 4,738   |
| Partial Hip Replacement                       | 2002      |  |  | 0.94  |                                  | 1.04   |                                      |  |   |
|   | 2003      |  |  | 0.91  |                                  | 1.04   |                                      |  |   |
|   | 2004      |  |  | 0.84  |                                  | 0.98   |                                      |  |   |
|   | 2002-2004 | 213,461  | 37,133   | 0.90  | 11.28%                           | 1.02   | 6.25%                                | 11.57%   | 2,341   |
| Back and Neck Surgery (without Spinal Fusion) | 2002      |  |  | 0.96  |                                  | 1.04   |                                      |  |   |
|   | 2003      |  |  | 0.89  |                                  | 0.99   |                                      |  |   |
|   | 2004      |  |  | 0.97  |                                  | 1.02   |                                      |  |   |
|   | 2002-2004 | 211,227  | 45,957   | 0.94  | -1.32%                           | 1.01   | 1.20%                                | 6.79%  | 1,018   |

| Diagnosis or Procedure                   | Year      | Total Number of U.S. Medicare Hospitalizations | Total Number of U.S. Medicare DH-CE Hospitalizations | DH-CE Hospitals Average Observed Inhospital Complications to Expected Inhospital Complications Ratio <sup>1</sup> | % Improvement by DH-CE Hospitals | All Other U.S. Hospitals Average Observed Inhospital Complications to Expected Inhospital Complications Ratio <sup>2</sup> | % Improvement by All Other Hospitals | Relative Risk Reduction Associated with DH-CE Hospitals Compared to All Other U.S. Hospitals | Number of Patients That Could Have Been Avoided Developing >1 Post-Op Complications If All Patients Treated at DH-CE Hospitals (2002-2004) <sup>3</sup> |
|--|-----------|--|--|---|----------------------------------|--|--------------------------------------|--|---|
| Spinal Fusion                            | 2002      |  |  | 0.93  |                                  | 1.01   |                                      |  |   |
|  | 2003      |  |  | 0.85  |                                  | 1.04   |                                      |  |   |
|  | 2004      |  |  | 0.90  |                                  | 1.03   |                                      |  |   |
|  | 2002-2004 | 126,382  | 27,651   | 0.89  | 2.63%                            | 1.03   | -2.37%                               | 13.14%   | 1,701   |
| Carotid Endarterectomy                   | 2002      |  |  | 0.97  |                                  | 1.03   |                                      |  |   |
|  | 2003      |  |  | 0.92  |                                  | 1.02   |                                      |  |   |
|  | 2004      |  |  | 0.81  |                                  | 0.85   |                                      |  |   |
|  | 2002-2004 | 243,070  | 51,030   | 0.92  | 16.67%                           | 1.01   | 17.55%                               | 8.62%  | 877   |
| Peripheral Vascular Bypass               | 2002      |  |  | 1.06  |                                  | 1.06   |                                      |  |   |
|  | 2003      |  |  | 0.97  |                                  | 1.04   |                                      |  |   |
|  | 2004      |  |  | 0.92  |                                  | 0.94   |                                      |  |   |
|  | 2002-2004 | 78,260   | 16,741   | 0.95  | 13.68%                           | 1.02   | 11.21%                               | 7.44%  | 453   |
| Prostatectomy                            | 2002      |  |  | 0.88  |                                  | 1.05   |                                      |  |   |
|  | 2003      |  |  | 0.85  |                                  | 1.00   |                                      |  |   |
|  | 2004      |  |  | 0.83  |                                  | 1.04   |                                      |  |   |
|  | 2002-2004 | 258,052  | 47,160   | 0.85  | 5.54%                            | 1.03   | 1.83%                                | 16.94%   | 1,683   |
| Cholecystectomy                          | 2002      |  |  | 0.94  |                                  | 1.02   |                                      |  |   |
|  | 2003      |  |  | 0.87  |                                  | 1.02   |                                      |  |   |
|  | 2004      |  |  | 0.91  |                                  | 1.01   |                                      |  |   |
|  | 2002-2004 | 299,392  | 52,131   | 0.90  | 3.47%                            | 1.02   | 0.90%                                | 11.32%   | 3,872   |
| Totals                                   |           | 2,639,834                                      | 501,886  | -   | -                                | -  | -                                    | -  | 21,896  |
| 3 Year Performance Averages <sup>4</sup> |           | -  | -  | 0.88  | 10.44%                           | 1.02   | 7.42%                                | 13.71%   | -   |

- <sup>1</sup> All 3 year aggregate outcomes were statistically significantly better than expected ( $p < 0.05$ ) for DH-CE hospitals
- <sup>2</sup> All 3 year aggregate outcomes were statistically significantly worse than expected ( $p < 0.05$ ) for All Other hospitals except for Total Hip Replacement, Back & Neck Surgery without Spinal Fusion, Carotid Endarterectomy and Peripheral Vascular Bypass which were not statistically significant different from expected
- <sup>3</sup> Complications avoided calculated (data not shown): All Other hospitals' 3 year actual number of patients with > complications- (All Other hospitals' 3 year expected number of patients with >1 x DH-CE O/E ratio)
- <sup>4</sup> All averages are weighted averages

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## ***Exhibit D: Hospital Report Card™ Mortality and Complication Based Outcomes 2006 Methodology White Paper***

### ***Introduction***

To help consumers evaluate and compare hospital performance, HealthGrades analyzed patient outcome data for virtually every hospital in the country. HealthGrades purchased the initial data from the Centers for Medicare and Medicaid Services (CMS). The Medicare data (MedPAR file) from CMS contained the inpatient records for Medicare patients.

Ratings were based upon two different risk-adjustment methodologies.

- For 27 medical issues, the risk adjustment was based upon the HealthGrades methodology described in the Multivariate Logistic Regression-Based Ratings section of this white paper.
- For Respiratory Failure and for Gastrointestinal Procedures and Surgeries, the risk adjustment was based upon APR-DRG methodology developed by 3M™ Corporation. APR-DRG stands for All Patient Refined Diagnosis Related Group. (All copyrights in and to APR-DRGs are owned by 3M™. All rights reserved.) This methodology is described in the APR-DRG-Based Ratings section of this white paper.

The purpose of risk adjustment is to obtain fair statistical comparisons between disparate populations or groups. Significant differences in demographic and clinical risk factors are found among patients treated in different hospitals. Risk adjustment of the data is needed to make accurate and valid comparisons of clinical outcomes at different hospitals.

### ***Data Acquisition***

The MedPAR data was selected for several reasons. First, it included virtually every hospital in the country, with the exception of military and Veterans Administration hospitals. Second, hospitals were required by law to submit complete and accurate information with substantial penalties for those that report inaccurate or incomplete data. Third, the Medicare population represented a majority of the patients for virtually all of the clinical categories studied, with approximately 55 percent to 60 percent of all cardiac patients and 75 percent to 80 percent of all joint replacement surgeries, for example. However, since the Appendectomy cohort includes very few cases over 65 years of age, all payer state data was used to rate hospitals in those states where state data are available.

For Multivariate Logistic Regression-Based Ratings (see below), HealthGrades conducted a series of data quality checks to preserve the integrity of the ratings. Based on the results of these checks, we excluded a limited number of cases because they were inappropriate for inclusion in the database or miscoded.

Examples of excluded patient records were:

- Patients under the age of 65 (except Appendectomy)
- Patients who left the hospital against medical advice or who were transferred to another acute care hospital



- Patients discharged alive with a length of stay equal to or less than one day (except for Coronary Interventional Procedures, Heart Attack, Heart Failure, Carotid Endarterectomy, Back and Neck Surgery (Spinal Fusion), Back and Neck Surgery (except Spinal Fusion), Chronic Obstructive Pulmonary Disease, Community Acquired Pneumonia, Peripheral Vascular Bypass, and Atrial Fibrillation)
- Patients who were still in the hospital when the Medicare claim was filed
- Patients with an invalid gender

## **Methodology for Ratings**

Our methodology takes into account patient characteristics such as age, sex, and underlying medical conditions that could increase the patient's risk of mortality or complication. Specifics about the statistical methods used are provided here and include:

- Multivariate Logistic Regression-Based Ratings
- APR-DRG-Based Ratings

## **Multivariate Logistic Regression-Based Ratings**

The in-hospital data for 27 diagnoses and procedures on the HealthGrades Web site represent three years of patient discharges from 2002 to 2004 for MedPAR and three years of patient discharges from 2001 to 2003 for state data.

In the initial analysis of the data, a separate data set was created for each group of patients having a specific procedure or diagnosis based on ICD-9-CM coding (e.g., coronary bypass surgery, total hip replacement). Each group of patients was defined by using the information on diagnoses and procedures coded in the patient records. See Appendix A for a list of the diagnosis and procedure codes that define each patient cohort. The quality measure for some cohorts was mortality, whereas—for other cohorts—the quality measure was major complications.

For each patient cohort, we developed a list of specific procedures (e.g., quadruple bypass surgery), a list of risk factors (Appendix C), and a list of post-surgical complications. These latter two lists were developed in two steps:

- 1 We identified all diagnoses occurring in more than one percent of the patients for the current analysis and the previous analysis.
- 2 We used a team of clinical and coding experts to identify the complications in the list created in Step One.

Some diagnosis codes were merged together (e.g., primary and secondary pulmonary hypertension) to minimize the impact of coding variations.

Outcomes were binary, with documented major/minor complications either present or not, and patients recorded as either alive or expired. See Appendix B for a list of complications included in the quality measure "Major Complications." In cohorts where the quality measure is major complications, mortality is considered a complication. See Appendix C for a list of the top five risk factors for each procedure or diagnosis.

## Risk-Adjustment Methodology

Fair and valid comparisons between hospital providers can be made only to the extent that the risk-adjustment methodology considers important differences in patient demographic and clinical characteristics. The risk-adjustment methodology used by HealthGrades defines risk factors as those clinical and demographic variables that influence patient outcomes in significant and systematic ways. Risk factors may include age, sex, specific procedure performed, and comorbid conditions such as hypertension, chronic renal failure, heart failure, and diabetes. The methodology is disease-specific and outcome-specific. This means that individual risk models are constructed and tailored for each clinical condition or procedure, and also for each outcome.

Developing the HealthGrades ratings involved four steps for each cohort (e.g., coronary bypass surgery) and quality measure (e.g., in-hospital mortality).

- 1 First, the predicted value (e.g., predicted mortality) was obtained using logistic regression models discussed in the next section.
- 2 Second, the predicted value was compared with the actual, or observed, value (e.g., actual mortality).
- 3 Third, a test was conducted to determine whether the difference between the predicted and actual values was statistically significant. This test was performed to make sure that differences were very unlikely to be caused by chance alone.
- 4 Fourth, a star rating was assigned based upon the outcome of the statistical test.

## Statistical Models

Unique statistical models were developed for each patient cohort and each outcome using logistic regression.

Comorbid diagnoses (e.g., hypertension, chronic renal failure, anemia, diabetes), demographic characteristics (e.g., age and sex), and specific procedures (where clinically relevant) were classified as potential risk factors. We used logistic regression to determine which of these were actually risk factors and to what extent they were correlated with the quality measure (e.g., mortality). A risk factor stayed in the model if it had an odds ratio greater than one (excluding clinically relevant procedures or cohort defining principal diagnosis) and was also statistically significant ( $p < 0.05$ ) in explaining variation. Exceptions to this rule should be noted for the cardiac service line (specifically CABG, PCI and AMI) where cardiogenic shock, anoxic brain injury, and cardiac arrest were excluded from the final model as risk factors. Complications were *not* counted as risk factors as they were considered a result of care received during the admission.

The statistical models were checked for validity and finalized. All of the models were highly significant, with C-statistics ranging from ~ 0.6 to ~ 0.9. These cohort and outcome-specific models were then used to estimate the probability of the outcome for each patient in the cohort. Patients were then aggregated for each hospital to obtain the predicted outcome for each hospital.

Statistical significance tests were performed to identify, by hospital, whether the actual and predicted rates were significantly different. We used a binomial distribution to establish an approximate 90% confidence interval.

## Assignment of Star Ratings

The following rating system was applied to the data for all procedures and diagnoses:

- ★★★★★ Actual performance was better than predicted and the difference was statistically significant.
- ★★★ Actual performance was not significantly different from what was predicted.
- ★ Actual performance was worse than predicted and the difference was statistically significant.

In general, 70 percent to 80 percent of hospitals in each procedure/diagnosis are classified as three stars, with actual results statistically the same as predicted results. Approximately 10 percent to 15 percent were one-star hospitals and 10 percent to 15 percent were five-star hospitals. The data fell out in a fairly well structured bell-shaped curve.

## APR-DRG-Based Ratings

For Gastrointestinal Procedures and Surgeries and Respiratory Failure, the risk adjustment was based upon APR-DRGs, a methodology developed by 3M™ Corporation. APR-DRGs are an enhanced extension of the basic DRG (diagnosis related group) concept developed by 3M™'s Clinical Research Group, the National Association of Children's Hospitals and Research Institutes (NACHRI), and several physician groups.



While DRGs focus on the Medicare population, APR-DRGs describe a complete cross-section of acute care patients and are specifically designed to adjust data for severity of illness (How sick is the patient?) and risk of mortality (How likely is it that the patient will die?).

The fundamental principle of APR-DRGs is that the severity of illness and risk of mortality are both dependent on the patient's underlying condition. High severity of illness and risk of mortality are characterized by multiple serious diseases and the interactions between the disorders.

The 3M™ APR-DRG methodology is the most widely used severity-of-illness and risk-of-mortality adjustment tool available today. It has become the standard for adjusting large volumes of data to account for differences related to the individual's severity of illness or risk of mortality. As a result, the focus can be on the differences in clinical care, thus providing equitable comparisons of quality and cost of care. APR-DRGs are also recognized as the tool of choice by commissions, state agencies, and others who disseminate comparative performance data to regulators, payers and the general public.

## Data Analysis

The output from the APR-DRG software was twofold:

- It told us how many patients had Respiratory Failure or Gastrointestinal Procedures or Surgeries in each hospital.
- It identified each patient as being in one of four subclasses of mortality risk:
  - Minor
  - Major
  - Moderate
  - Extreme

HealthGrades then took the above APR-DRG output and went through these steps:

- 1 For each patient, a predicted probability of death was calculated based on the average national mortality rate for that mortality risk class in that APR-DRG.
- 2 Based on the observed and predicted deaths, a z-score was calculated for each hospital across the APR-DRGs, which define the cohort.
- 3 Any hospital that did not have at least 30 cases across three years of data was removed, and any hospital that did not have at least one case in the most current year was removed.

This z-score methodology was compared with the previously used chi-squared test and shown to produce nearly identical results.

### Assignment of Star Ratings

The following rating system was applied to the data for all procedures and diagnoses:

- ★★★★★ Actual performance was better than predicted and the difference was statistically significant.
- ★★★ Actual performance was not significantly different from what was predicted.
- ★ Actual performance was worse than predicted and the difference was statistically significant.

### Limitations of the Data Models

It must be understood that while these models may be valuable in identifying hospitals that perform better than others, one should not use this information alone to determine the quality of care provided at each hospital. The models are limited by the following factors:

- Cases may have been coded incorrectly or incompletely by the hospital.
- The models can only account for risk factors that are coded into the billing data—if a particular risk factor was not coded into the billing data, such as a patient's socioeconomic status and health behavior, then it was not accounted for with these models.
- Although Health Grades, Inc. has taken steps to carefully compile these data using its methodology, no techniques are infallible, and therefore some information may be missing, outdated or incorrect.

Please note that a high ranking for a particular hospital is not a recommendation or endorsement by Health Grades, Inc. of a particular hospital; it means that the data associated with a particular hospital has met the foregoing qualifications. Only individual patients can decide whether a particular hospital is suited for their unique needs.

Also note that if more than one hospital reported to CMS under a single provider ID, HealthGrades analyzed patient outcome data for those hospitals as a single unit. (Throughout this document, therefore, "hospital" refers to one hospital or a group of hospitals reporting under a single provider ID.)

## Appendix A: Patient Cohorts and Related ICD-9-CM Codes

| Patient Cohort                               | ICD-9-CM Procedure/Diagnosis Codes and Criteria   |
|--|---|
| Appendectomy                                 | Principal Procedures – Inclusions: 47.01, 47.09<br>Procedures – Exclusions: 37.5, 37.51, 37.52, 37.53, 37.54<br>Note: This cohort uses all payer data from states which provide it  |
| Atrial Fibrillation                          | Principal Diagnoses – Inclusions: 427.31<br>Procedures – Exclusions: 37.5, 37.51, 37.52, 37.53, 37.54<br>Diagnoses – Exclusions: 414.06, 414.07, V66.7  |
| Back and Neck Surgery (Spinal Fusion)        | Principal Procedures – Inclusions: 81.00, 81.01, 81.02, 81.03, 81.04, 81.05, 81.06, 81.07, 81.08, 81.61, 81.62, 81.63, 81.64<br>Procedures – Exclusions: 03.02, 37.5, 37.51, 37.52, 37.53, 37.54, 81.3, 81.30, 81.31, 81.32, 81.33, 81.34, 81.35, 81.36, 81.37, 81.38, 81.39<br>Diagnoses – Exclusions: 722.80, 722.81, 722.82, 722.83, V45.4   |
| Back and Neck Surgery (except Spinal Fusion) | Principal Procedures – Inclusions: 03.09, 03.53, 80.50, 80.51, 80.59<br>Procedures – Exclusions: 03.02, 37.5, 37.51, 37.52, 37.53, 37.54, 81.00, 81.01, 81.02, 81.03, 81.04, 81.05, 81.06, 81.07, 81.08, 81.09, 81.3, 81.30, 81.31, 81.32, 81.33, 81.34, 81.35, 81.36, 81.37, 81.38, 81.39, 81.61, 81.62, 81.63, 81.64<br>Diagnoses – Exclusions: 722.80, 722.81, 722.82, 722.83, V45.4   |
| Bowel Obstruction                            | Principal Diagnoses – Inclusions: 277.01, 532.01, 532.11, 532.21, 532.31, 532.41, 532.51, 532.61, 532.71, 532.91, 534.01, 534.11, 534.21, 534.31, 534.41, 534.51, 534.61, 534.71, 534.91, 537.2, 537.3, 550.10, 550.11, 550.12, 550.13, 552.00, 552.01, 552.02, 552.03, 552.1, 552.20, 552.21, 552.29, 552.8, 552.9, 557.0, 560.0, 560.1, 560.2, 560.30, 560.31, 560.39, 560.81, 560.89, 560.9, 751.1, 751.2, 936, 937<br>Procedures – Exclusions: 37.5, 37.51, 37.52, 37.53, 37.54<br>Diagnoses – Exclusions: V66.7  |
| Carotid Endarterectomy                       | Principal Procedures – Inclusions: 38.12, 39.72<br>Procedures – Exclusions: 36.1, 36.10, 36.11, 36.12, 36.13, 36.14, 36.15, 36.16, 36.17, 36.19, 37.5, 37.51, 37.52, 37.53, 37.54, 38.08, 38.16, 38.18, 38.36, 39.24, 39.25, 39.29, 39.50, 39.59, 39.90   |
| Cholecystectomy                              | Principal Procedures – Inclusions: 51.21, 51.22, 51.23, 51.24<br>Procedures – Exclusions: 37.5, 37.51, 37.52, 37.53, 37.54  |
| Chronic Obstructive Pulmonary Disease (COPD) | Principal Diagnoses – Inclusions: 491.1, 491.20, 491.21, 491.8, 491.9, 492.8, 493.20, 493.21, 493.22, 494, 494.0, 494.1, 496<br>Procedures – Exclusions: 37.5, 37.51, 37.52, 37.53, 37.54<br>Diagnoses – Exclusions: 480.3, V66.7   |
| Community Acquired Pneumonia                 | Principal Diagnoses – Inclusions: 480.0, 480.1, 480.2, 480.8, 480.9, 481, 482.2, 482.30, 482.31, 482.32, 482.39, 482.9, 483.0, 483.1, 483.8, 485, 486, 487.0<br>Procedures – Exclusions: 37.5, 37.51, 37.52, 37.53, 37.54<br>Diagnoses – Exclusions: 480.3, V66.7   |
| Coronary Bypass Surgery                      | Principal Procedures – Inclusions: 36.10, 36.11, 36.12, 36.13, 36.14, 36.15, 36.16, 36.19<br>Procedures – Exclusions: 35.1, 35.10, 35.11, 35.12, 35.13, 35.14, 35.2, 35.20, 35.21, 35.22, 35.23, 35.24, 35.25, 35.26, 35.27, 35.28, 37.5, 37.51, 37.52, 37.53, 37.54, 38.12<br>Diagnoses – Exclusions: 414.06, 414.07   |
| Coronary Interventional Procedures           | Principal or Secondary Procedures – Inclusions: 36.01, 36.02, 36.05, 36.06, 36.07, 36.09<br>Procedures – Exclusions: 35.1, 35.10, 35.11, 35.12, 35.13, 35.14, 35.2, 35.20, 35.21, 35.22, 35.23, 35.24, 35.25, 35.26, 35.27, 35.28, 36.10, 36.11, 36.12, 36.13, 36.14, 36.15, 36.16, 36.19, 37.5, 37.51, 37.52, 37.53, 37.54<br>Diagnoses – Exclusions: 414.06, 414.07   |
| Diabetic Acidosis and Coma                   | Principal or Secondary Procedures – Inclusions: 250.10, 250.11, 250.12, 250.13, 250.20, 250.21, 250.22, 250.23, 250.30, 250.31, 250.32, 250.33, 250.80, 250.81, 250.82, 250.83<br>Procedures – Exclusions: 37.5, 37.51, 37.52, 37.53, 37.54<br>Diagnoses – Exclusions: V66.7  |
| Gastrointestinal Bleed                       | Principal Diagnoses – Inclusions: 456.0, 456.20, 530.21, 530.7, 530.82, 531.00, 531.01, 531.20, 531.21, 531.40, 531.41, 531.60, 531.61, 532.00, 532.01, 532.20, 532.21, 532.40, 532.41, 532.60, 532.61, 533.00, 533.01, 533.20, 533.21, 533.40, 533.41, 533.60, 533.61, 534.0, 534.00, 534.01, 534.20, 534.21, 534.40, 534.41, 534.60, 534.61, 535.01, 535.11, 535.21, 535.31, 535.41, 535.51, 535.61, 537.83, 537.84, 562.02, 562.03, 562.12, 562.13, 569.3, 569.85, 569.86, 578, 578.9, 751.0<br>Procedures – Exclusions: 37.5, 37.51, 37.52, 37.53, 37.54<br>Diagnoses – Exclusions: V66.7 |
| Gastrointestinal Procedures and Surgeries    | APR-DRG: 220-224, 226, 229, 260, 261, 264   |

| Patient Cohort                             | ICD-9-CM Procedure/Diagnosis Codes and Criteria   |
|--|---|
| Heart Attack                               | Principal Diagnoses – Inclusions: 410.01, 410.11, 410.21, 410.31, 410.41, 410.51, 410.61, 410.71, 410.81, 410.91<br>Diagnoses – Exclusions: 414.06, 414.07, V66.7   |
| Heart Failure                              | Principal Diagnoses – Inclusions: 398.91, 402.01, 402.11, 402.91, 404.01, 404.03, 404.11, 404.13, 404.91, 404.93, 428.0, 428.1, 428.2, 428.20, 428.21, 428.22, 428.23, 428.3, 428.30, 428.31, 428.32, 428.33, 428.4, 428.40, 428.41, 428.42, 428.43, 428.9<br>Procedures – Exclusions: 39.95<br>Diagnoses – Exclusions: 414.06, 414.07, V66.7   |
| Hip Fracture Repair                        | Principal Procedures – Inclusions: 79.05, 79.15, 79.25, 79.35<br>Procedures – Exclusions: 37.5, 37.51, 37.52, 37.53, 37.54, 81.54, 81.55<br>Diagnoses – Exclusions: 800.6, 820.10, 820.11, 820.12, 820.13, 820.19, 820.30, 820.31, 820.32, 820.9, 821.10, 821.11, 821.30, 821.31, 821.32, 821.33, 821.39, V66.7   |
| Pancreatitis                               | Principal Diagnoses – Inclusions: 577.0, 577.1<br>Procedures – Exclusions: 37.5, 37.51, 37.52, 37.53, 37.54   |
| Partial Hip Replacement                    | Principal Procedures – Inclusions: 81.52<br>Procedures – Exclusions: 37.5, 37.51, 37.52, 37.53, 37.54, 81.54, 81.55<br>Diagnoses – Exclusions: 800.6, 820.10, 820.11, 820.12, 820.13, 820.19, 820.20, 820.22, 820.30, 820.31, 820.32, 820.9, 821.10, 821.11, 821.30, 821.31, 821.32, 821.33, 821.39, V66.7  |
| Peripheral Vascular Bypass                 | Principal Procedures – Inclusions: 39.29<br>Principal Diagnoses – Inclusions: 250.60, 250.61, 250.62, 250.63, 250.70, 250.71, 250.72, 250.73, 250.80, 250.81, 250.82, 250.83, 440.20, 440.21, 440.22, 440.23, 440.24, 440.29, 440.30, 440.32, 442.2, 442.3, 443.89, 443.9, 444.22, 444.81, 445.02, 447.1, 681.10, 682.6, 682.7, 686.8, 707.10, 707.12, 707.13, 707.14, 707.15, 707.19, 707.8, 730.06, 730.07, 730.16, 730.17, 730.18, 730.26, 730.27, 785.4, 902.53, 904.41<br>Procedures – Exclusions: 37.5, 37.51, 37.52, 37.53, 37.54, 39.25, 39.49<br>Diagnoses – Exclusions: 440.31, 445.01  |
| Prostatectomy                              | Principal Procedures – Inclusions: 60.21, 60.29, 60.3, 60.4, 60.5, 60.61, 60.62, 60.69<br>Procedures – Exclusions: 37.5, 37.51, 37.52, 37.53, 37.54   |
| Pulmonary Embolism                         | Principal Diagnoses – Inclusions: 415.11, 415.19<br>Procedures – Exclusions: 37.5, 37.51, 37.52, 37.53, 37.54<br>Diagnoses – Exclusions: V66.7  |
| Resection / Replacement of Abdominal Aorta | Principal Procedures – Inclusions: 38.34, 38.44, 38.64, 39.71<br>Procedures – Exclusions: 35.10, 35.11, 35.12, 35.13, 35.14, 35.20, 35.21, 35.22, 35.23, 35.24, 35.25, 35.26, 35.27, 35.28, 36.1, 36.10, 36.11, 36.12, 36.13, 36.14, 36.15, 36.16, 36.17, 36.19, 37.5, 37.51, 37.52, 37.53, 37.54, 38.08, 38.16, 38.18, 38.36, 38.45, 39.24, 39.25, 39.29, 39.50, 39.59<br>Diagnoses – Exclusions: 441.00, 441.01, 441.02, 441.03, 441.1, 441.2, 441.6, 441.7, 441.9  |
| Respiratory Failure                        | APR-DRG: 130, 133   |
| Sepsis                                     | Principal Diagnoses – Inclusions: 003.1, 022.3, 027.0, 036.2, 036.3, 038.0, 038.10, 038.11, 038.19, 038.2, 038.3, 038.40, 038.41, 038.42, 038.43, 038.44, 038.49, 038.8, 038.9, 054.5, 785.52, 995.90, 995.91, 995.92, 999.3<br>Procedures – Exclusions: 37.5, 37.51, 37.52, 37.53, 37.54<br>Diagnoses – Exclusions: V66.7  |
| Stroke                                     | Principal Diagnoses – Inclusions: 430, 431, 432.0, 432.1, 432.9, 433.01, 433.11, 433.21, 433.31, 433.81, 433.91, 434.01, 434.11, 434.91, 436<br>Procedures – Exclusions: 37.5, 37.51, 37.52, 37.53, 37.54<br>Diagnoses – Exclusions: V66.7  |
| Total Hip Replacement                      | Principal Procedures – Inclusions: 81.51<br>Procedures – Exclusions: 37.5, 37.51, 37.52, 37.53, 37.54, 78.65, 78.67, 80.05, 80.06, 81.53, 81.54, 81.55<br>Diagnoses – Exclusions: E800, E800.0, E800.1, E800.2, E800.3, E800.8, E800.9, E801, E801.0, E801.1, E801.2, E801.3, E801.8, E801.9, E802, E802.0, E802.1, E802.2, E802.3, E802.8, E802.9, E803, E803.0, E803.1, E803.2, E803.3, E803.8, E803.9, E804, E804.0, E804.1, E804.2, E804.3, E804.8, E804.9, E805, E805.0, E805.1, E805.2, E805.3, E805.8, E805.9, E806, E806.0, E806.1, E806.2, E806.3, E806.8, E806.9, E807, E807.0, E807.1, E807.2, E807.3, E807.8, E807.9, E810, E810.0, E810.1, E810.2, E810.3, E810.4, E810.5, E810.6, E810.7, E810.8, E810.9, E811, E811.0, E811.1, E811.2, E811.3, E811.4, E811.5, E811.6, E811.7, E811.8, E811.9, E812, E812.0, E812.1, E812.2, E812.3, E812.4, E812.5, E812.6, E812.7, E812.8, E812.9, E813, E813.0, E813.1, E813.2, E813.3, E813.4, E813.5, E813.6, E813.7, E813.8, E813.9, E814, E814.0, E814.1, E814.2, E814.3, E814.4, E814.5, E814.6, E814.7, E814.8, E814.9, E815, E815.0, E815.1, E815.2, E815.3, E815.4, E815.5, E815.6, E815.7, E815.8, E815.9, E816, E816.0, E816.1, E816.2, E816.3, E816.4, E816.5, E816.6, E816.7, |

|                           |   |
|---------------------------|---|
|                           | E816.8, E816.9, E817, E817.0, E817.1, E817.2, E817.3, E817.4, E817.5, E817.6, E817.7, E817.8, E817.9, E818, E818.0, E818.1, E818.2, E818.3, E818.4, E818.5, E818.6, E818.7, E818.8, E818.9, E819, E819.0, E819.1, E819.2, E819.3, E819.4, E819.5, E819.6, E819.7, E819.8, E819.9, E820, E820.0, E820.1, E820.2, E820.3, E820.4, E820.5, E820.6, E820.7, E820.8, E820.9, E821, E821.0, E821.1, E821.2, E821.3, E821.4, E821.5, E821.6, E821.7, E821.8, E821.9, E822, E822.0, E822.1, E822.2, E822.3, E822.4, E822.5, E822.6, E822.7, E822.8, E822.9, E823, E823.0, E823.1, E823.2, E823.3, E823.4, E823.5, E823.6, E823.7, E823.8, E823.9, E824, E824.0, E824.1, E824.2, E824.3, E824.4, E824.5, E824.6, E824.7, E824.8, E824.9, E825, E825.0, E825.1, E825.2, E825.3, E825.4, E825.5, E825.6, E825.7, E825.8, E825.9, E826, E826.0, E826.1, E826.2, E826.3, E826.4, E826.8, E826.9, E827, E827.0, E827.2, E827.3, E827.4, E827.8, E827.9, E828, E828.0, E828.2, E828.4, E828.8, E828.9, E829, E829.0, E829.4, E829.8, E829.9, E830, E830.0, E830.1, E830.2, E830.3, E830.4, E830.5, E830.6, E830.8, E830.9, E831, E831.0, E831.1, E831.2, E831.3, E831.4, E831.5, E831.6, E831.8, E831.9, E832, E832.0, E832.1, E832.2, E832.3, E832.4, E832.5, E832.6, E832.8, E832.9, E833, E833.0, E833.1, E833.2, E833.3, E833.4, E833.5, E833.6, E833.8, E833.9, E834, E834.0, E834.1, E834.2, E834.3, E834.4, E834.5, E834.6, E834.8, E834.9, E835, E835.0, E835.1, E835.2, E835.3, E835.4, E835.5, E835.6, E835.8, E835.9, E836, E836.0, E836.1, E836.2, E836.3, E836.4, E836.5, E836.6, E836.8, E836.9, E837, E837.0, E837.1, E837.2, E837.3, E837.4, E837.5, E837.6, E837.8, E837.9, E838, E838.0, E838.1, E838.2, E838.3, E838.4, E838.5, E838.6, E838.8, E838.9, E840, E840.0, E840.1, E840.2, E840.3, E840.4, E840.5, E840.6, E840.7, E840.8, E840.9, E841, E841.0, E841.1, E841.2, E841.3, E841.4, E841.5, E841.6, E841.7, E841.8, E841.9, E842, E842.6, E842.7, E842.8, E842.9, E843, E843.0, E843.1, E843.2, E843.3, E843.4, E843.5, E843.6, E843.7, E843.8, E843.9, E844, E844.0, E844.1, E844.2, E844.3, E844.4, E844.5, E844.6, E844.7, E844.8, E844.9, E845, E845.0, E845.8, E845.9, E846, E847, E848, E849, E849.0, E849.1, E849.2, E849.3, E849.4, E849.5, E849.6, E849.7, E849.8, E849.9, E880, E880.0, E880.1, E880.9, E881, E881.0, E881.1, E882, E883, E883.0, E883.1, E883.2, E883.9, E884, E884.0, E884.1, E884.2, E884.3, E884.4, E884.5, E884.6, E884.9, E885, E885.0, E885.1, E885.2, E885.3, E885.4, E885.9, E886, E886.0, E886.9, E887, E888, E888.0, E888.1, E888.8, E888.9, E890.0, E890.8, E891.0, E891.8, E916, E917.0, E917.1, E917.2, E917.3, E917.4, E917.5, E917.6, E917.7, E917.8, E917.9, E918, E919.0, E919.1, E919.2, E919.3, E919.4, E919.5, E919.6, E919.7, E919.8, E919.9, E920, E920.0, E920.1, E920.2, E920.3, E920.4, E920.5, E920.8, E920.9, E921, E921.0, E921.1, E921.8, E921.9, E922, E922.0, E922.1, E922.2, E922.3, E922.4, E922.5, E922.8, E922.9, E923, E923.0, E923.1, E923.2, E923.8, E923.9, E928.8, E928.9, E929, E929.0, E929.1, E929.2, E929.3, E929.4, E929.5, E929.8, E929.9, E955.0, E955.1, E955.2, E955.3, E955.4, E955.5, E955.6, E955.7, E955.9, E956, E957.0, E957.1, E957.2, E957.9, E958.0, E958.5, E958.6, E960.0, E965.0, E965.1, E965.2, E965.3, E965.4, E965.5, E965.6, E965.7, E965.8, E965.9, E966, E968.1, E968.2, E968.5, E968.6, E969, E970, E971, E973, E974, E977, E985, E985.0, E985.1, E985.2, E985.3, E985.4, E985.5, E985.6, E985.7, E986, E987, E987.0, E987.1, E987.2, E987.9, E988, E988.0, E988.5, E988.6, E989, V15.5, V58.43 |
| Total Knee Replacement    | Principal Procedures – Inclusions: 81.54<br>Procedures – Exclusions: 37.5, 37.51, 37.52, 37.53, 37.54, 78.65, 78.67, 80.05, 80.06, 81.51, 81.52, 81.53  |
| Valve Replacement Surgery | Principal or Secondary Procedures – Inclusions: 35.20, 35.21, 35.22, 35.23, 35.24, 35.25, 35.26, 35.27, 35.28<br>Procedures – Exclusions: 35.1, 35.33, 37.5, 37.51, 37.52, 37.53, 37.54, 38.12<br>Diagnoses – Exclusions: 414.06, 414.07, 441.2   |

## Appendix B: Major Complications

| Major Complications – Appendectomy |                          |        |                          |
|------------------------------------|--------------------------|--------|--------------------------|
| 427.31                             | ATRIAL FIBRILLATION      | 560.9  | INTESTINAL OBSTRUCTN NOS |
| 427.89                             | CARDIAC DYSRHYTHMIAS NEC | 584.9  | ACUTE RENAL FAILURE, NOS |
| 428.0                              | CONGESTIVE HEART FAILURE | 593.9  | KIDNEY & URETER DIS NOS  |
| 486                                | PNEUMONIA-ORGANISM NOS   | 682.2  | CELLULITIS/ABSCESS-TRUNK |
| 511.9                              | PLEURAL EFFUSION, NOS    | 997.1  | CARDIAC COMPLICATION NEC |
| 518.0                              | PULMONARY COLLAPSE       | 997.3  | RESPIR COMPLICATIONS NEC |
| 518.5                              | PULM INSUF PST TRAUM/SRG | 997.4  | DIGESTIVE SYST COMPL NEC |
| 518.81                             | RESPIRATORY FAILURE      | 997.5  | URINARY COMPLICATION NEC |
| 560.1                              | PARALYTIC ILEUS          | 998.59 | POSTOPERATIV INFECTN NEC |

| Major Complications – Back and Neck Surgery (Spinal Fusion) |                          |        |                          |
|---|--------------------------|--------|--------------------------|
| 427.31  | ATRIAL FIBRILLATION      | 482.41 | STAPH AUREUS PNEUMONIA   |
| 427.89  | CARDIAC DYSRHYTHMIAS NEC | 482.49 | STAPH PNEUMONIA NEC      |
| 428.0   | CONGESTIVE HEART FAILURE | 482.8  | PNEUMONIA-BACTERIA NEC   |
| 428.1   | LEFT HEART FAILURE       | 482.81 | PNEUMONIA DT ANAEROBES   |
| 428.2   | SYSTOLIC HEART FAILURE   | 482.82 | PNEUMONIA-E. COLI        |
| 428.20  | SYSTOLC HEART FAILUR NOS | 482.83 | PNEUMONIA-GRM NG BAC NEC |
| 428.21  | AC SYSTOLC HEART FAILURE | 482.84 | LEGIONNAIRES' DISEASE    |
| 428.23  | AC ON CHR SYSTOL HT FAIL | 482.89 | PNEUMONIA-BACTERIA NEC   |
| 428.3   | DIASTOLIC HEART FAILURE  | 482.9  | BACTERIAL PNEUMONIA, NOS |
| 428.30  | DIASTOLC HEART FAILR NOS | 483    | PNEUMONIA-OTHER ORGANISM |
| 428.31  | AC DIASTOL HEART FAILURE | 483.0  | PNEUMONIA-M. PNEUMONIAE  |
| 428.33  | AC ON CHR DIASTL HT FAIL | 483.1  | PNEUMONIA DT CHLAMYDIA   |
| 428.4   | CMB SYST & DIAST HT FAIL | 483.8  | PNEUMONIA DT ORGANSM NEC |
| 428.40  | CMB SYS/DIAS HT FAIL NOS | 484    | PNEUMONIA-OTH INFECT DIS |
| 428.41  | AC COMB SYS/DIAS HT FAIL | 484.1  | PNEUMONIA-CM INCLUSN DIS |
| 428.43  | AC ON CH SYS/DIA HT FAIL | 484.3  | PNEUMONIA-WHOOPING COUGH |
| 428.9   | HEART FAILURE, NOS       | 484.5  | PNEUMONIA IN ANTHRAX     |
| 480   | VIRAL PNEUMONIA          | 484.6  | PNEUMONIA-ASPERGILLOSIS  |
| 480.0   | PNEUMONIA DT ADENOVIRUS  | 484.7  | PNEUMON-SYST MYCOSES NEC |
| 480.1   | PNEUMONIA DUE TO RSV     | 484.8  | PNEUMON IN INFCT DIS NEC |
| 480.2   | PNEUMON-PARAINFLUENZA VR | 485    | BRONCHOPNEUM-ORGNISM NOS |
| 480.3   | PNEUMONIA DT SARS        | 486    | PNEUMONIA-ORGANISM NOS   |
| 480.8   | PNEUMONIA DT VIRUS NEC   | 518.0  | PULMONARY COLLAPSE       |
| 480.9   | VIRAL PNEUMONIA, NOS     | 518.5  | PULM INSUF PST TRAUM/SRG |
| 481   | PNEUMOCOCCAL PNEUMONIA   | 560.1  | PARALYTIC ILEUS          |
| 482   | OTHR BACTERIAL PNEUMONIA | 996.4  | MECH COMPL-INT ORTHO DEV |
| 482.0   | PNEUMONIA-K. PNEUMONIAE  | 996.77 | COMP NEC-INTRN JT PROSTH |
| 482.1   | PNEUMONIA DT PSEUDOMONAS | 996.78 | COMP NEC-ORTHOPD DEV NEC |
| 482.2   | PNEUMONIA-H. INFLUENZAE  | 997.1  | CARDIAC COMPLICATION NEC |
| 482.3   | PNEUMONIA-STREPTOCOCCUS  | 997.3  | RESPIR COMPLICATIONS NEC |
| 482.30  | PNEUMONIA-STREPTOCOC NOS | 997.4  | DIGESTIVE SYST COMPL NEC |
| 482.31  | PNEUMONIA-GROUP A STREP  | 997.5  | URINARY COMPLICATION NEC |
| 482.32  | PNEUMONIA-GROUP B STREP  | 998.11 | HEMORRHAGE COMPLIC PROC  |
| 482.39  | PNEUMONIA DT STREP NEC   | 998.2  | ACC PUNCTUR/LAC-PROC NEC |
| 482.4   | PNEUMONIA-STAPHYLOCOCCUS | 998.59 | POSTOPERATIV INFECTN NEC |
| 482.40  | STAPH PNEUMONIA NOS      |        |                          |

| Major Complications – Back and Neck Surgery (except Spinal Fusion) |                          |        |                          |
|--|--------------------------|--------|--------------------------|
| 427.31   | ATRIAL FIBRILLATION      | 518.0  | PULMONARY COLLAPSE       |
| 427.89   | CARDIAC DYSRHYTHMIAS NEC | 518.5  | PULM INSUF PST TRAUM/SRG |
| 428.0  | CONGESTIVE HEART FAILURE | 593.9  | KIDNEY & URETER DIS NOS  |
| 428.1  | LEFT HEART FAILURE       | 996.4  | MECH COMPL-INT ORTHO DEV |
| 428.2  | SYSTOLIC HEART FAILURE   | 996.77 | COMP NEC-INTRN JT PROSTH |
| 428.20   | SYSTOLC HEART FAILUR NOS | 996.78 | COMP NEC-ORTHOPD DEV NEC |
| 428.21   | AC SYSTOLC HEART FAILURE | 997.00 | NERVOUS SYST COMPLIC NOS |
| 428.23   | AC ON CHR SYSTOL HT FAIL | 997.02 | IATROGN C-VSC INFRCT/HEM |
| 428.3  | DIASTOLIC HEART FAILURE  | 997.09 | NERVOUS SYST COMPLIC NEC |
| 428.30   | DIASTOLC HEART FAILR NOS | 997.1  | CARDIAC COMPLICATION NEC |
| 428.31   | AC DIASTOL HEART FAILURE | 997.3  | RESPIR COMPLICATIONS NEC |
| 428.33   | AC ON CHR DIASTL HT FAIL | 997.4  | DIGESTIVE SYST COMPL NEC |
| 428.4  | CMB SYST & DIAST HT FAIL | 997.5  | URINARY COMPLICATION NEC |
| 428.40   | CMB SYS/DIAS HT FAIL NOS | 998.11 | HEMORRHAGE COMPLIC PROC  |
| 428.41   | AC COMB SYS/DIAS HT FAIL | 998.2  | ACC PUNCTUR/LAC-PROC NEC |
| 428.43   | AC ON CH SYS/DIA HT FAIL | 998.59 | POSTOPERATIV INFECTN NEC |
| 428.9  | HEART FAILURE, NOS       |        |                          |



| Major Complications – Carotid Endarterectomy |                          |                                  |
|--|--------------------------|----------------------------------|
| 427.31                                       | ATRIAL FIBRILLATION      | 428.41 AC COMB SYS/DIAS HT FAIL  |
| 427.89                                       | CARDIAC DYSRHYTHMIAS NEC | 428.43 AC ON CH SYS/DIA HT FAIL  |
| 428.0  | CONGESTIVE HEART FAILURE | 428.9 HEART FAILURE, NOS         |
| 428.1  | LEFT HEART FAILURE       | 458.2 IATROGENIC HYPOTENSION     |
| 428.2  | SYSTOLIC HEART FAILURE   | 997.00 NERVOUS SYST COMPLIC NOS  |
| 428.20                                       | SYSTOLC HEART FAILUR NOS | 997.01 CENTRL NERV SYST COMPLIC  |
| 428.21                                       | AC SYSTOLC HEART FAILURE | 997.02 IATROGN C-VSC INFRACT/HEM |
| 428.23                                       | AC ON CHR SYSTOL HT FAIL | 997.09 NERVOUS SYST COMPLIC NEC  |
| 428.3  | DIASTOLIC HEART FAILURE  | 997.1 CARDIAC COMPLICATION NEC   |
| 428.30                                       | DIASTOLC HEART FAILR NOS | 997.3 RESPIR COMPLICATIONS NEC   |
| 428.31                                       | AC DIASTOL HEART FAILURE | 997.4 DIGESTIVE SYST COMPL NEC   |
| 428.33                                       | AC ON CHR DIASTL HT FAIL | 998.11 HEMORRHAGE COMPLIC PROC   |
| 428.4  | CMB SYST & DIAST HT FAIL | 998.2 ACC PUNCTUR/LAC-PROC NEC   |
| 428.40                                       | CMB SYS/DIAS HT FAIL NOS | 998.59 POSTOPERATIV INFECTN NEC  |

| Major Complications – Cholecystectomy |                          |                                 |
|---------------------------------------|--------------------------|---------------------------------|
| 038                                   | SEPTICEMIA               | 482.1 PNEUMONIA DT PSEUDOMONAS  |
| 038.0                                 | STREPTOCOCCAL SEPTICEMIA | 482.2 PNEUMONIA-H. INFLUENZAE   |
| 038.1                                 | STAPHYLOCOCC SEPTICEMIA  | 482.3 PNEUMONIA-STREPTOCOCCUS   |
| 038.10                                | STAPHLOCOCC SEPTICEM NOS | 482.30 PNEUMONIA-STREPTOCOC NOS |
| 038.11                                | SEPTICEMIA-STAPH AUREUS  | 482.31 PNEUMONIA-GROUP A STREP  |
| 038.19                                | STAPHLOCOCC SEPTICEM NEC | 482.32 PNEUMONIA-GROUP B STREP  |
| 038.2                                 | PNEUMOCOCCAL SEPTICEMIA  | 482.39 PNEUMONIA DT STREP NEC   |
| 038.3                                 | SEPTICEMIA DT ANAEROBES  | 482.4 PNEUMONIA-STAPHYLOCOCCUS  |
| 038.4                                 | SEPTICEMIA GRAM-NEGS NEC | 482.40 STAPH PNEUMONIA NOS      |
| 038.40                                | SEPTICEMIA GRAM-NEGS NOS | 482.41 STAPH AUREUS PNEUMONIA   |
| 038.41                                | SEPTICEMIA-H. INFLUENZAE | 482.49 STAPH PNEUMONIA NEC      |
| 038.42                                | SEPTICEMIA DT E. COLI    | 482.8 PNEUMONIA-BACTERIA NEC    |
| 038.43                                | SEPTICEMIA - PSEUDOMONAS | 482.81 PNEUMONIA DT ANAEROBES   |
| 038.44                                | SEPTICMIA DT SERRATIA    | 482.82 PNEUMONIA-E. COLI        |
| 038.49                                | SEPTICEMIA GRAM-NEG NEC  | 482.83 PNEUMONIA-GRM NG BAC NEC |
| 038.8                                 | OTH SPECIFIED SEPTICEMIA | 482.84 LEGIONNAIRES' DISEASE    |
| 038.9                                 | UNSPECIFIED SEPTICEMIA   | 482.89 PNEUMONIA-BACTERIA NEC   |
| 427.31                                | ATRIAL FIBRILLATION      | 482.9 BACTERIAL PNEUMONIA, NOS  |
| 427.89                                | CARDIAC DYSRHYTHMIAS NEC | 483 PNEUMONIA-OTHER ORGANISM    |
| 428.0                                 | CONGESTIVE HEART FAILURE | 483.0 PNEUMONIA-M. PNEUMONIAE   |
| 428.1                                 | LEFT HEART FAILURE       | 483.1 PNEUMONIA DT CHLAMYDIA    |
| 428.2                                 | SYSTOLIC HEART FAILURE   | 483.8 PNEUMONIA DT ORGANSM NEC  |
| 428.20                                | SYSTOLC HEART FAILUR NOS | 484 PNEUMONIA-OTH INFECT DIS    |
| 428.21                                | AC SYSTOLC HEART FAILURE | 484.1 PNEUMONIA-CM INCLUSN DIS  |
| 428.23                                | AC ON CHR SYSTOL HT FAIL | 484.3 PNEUMONIA-WHOOPING COUGH  |
| 428.3                                 | DIASTOLIC HEART FAILURE  | 484.5 PNEUMONIA IN ANTHRAX      |
| 428.30                                | DIASTOLC HEART FAILR NOS | 484.6 PNEUMONIA-ASPERGILLOSIS   |
| 428.31                                | AC DIASTOL HEART FAILURE | 484.7 PNEUMON-SYST MYCOSES NEC  |
| 428.33                                | AC ON CHR DIASTL HT FAIL | 484.8 PNEUMON IN INFCT DIS NEC  |
| 428.4                                 | CMB SYST & DIAST HT FAIL | 485 BRONCHOPNEUM-ORGNSM NOS     |
| 428.40                                | CMB SYS/DIAS HT FAIL NOS | 486 PNEUMONIA-ORGANISM NOS      |
| 428.41                                | AC COMB SYS/DIAS HT FAIL | 511.9 PLEURAL EFFUSION, NOS     |
| 428.43                                | AC ON CH SYS/DIA HT FAIL | 518.0 PULMONARY COLLAPSE        |
| 428.9                                 | HEART FAILURE, NOS       | 518.5 PULM INSUF PST TRAUM/SRG  |
| 480                                   | VIRAL PNEUMONIA          | 518.81 RESPIRATORY FAILURE      |
| 480.0                                 | PNEUMONIA DT ADENOVIRUS  | 560.1 PARALYTIC ILEUS           |
| 480.1                                 | PNEUMONIA DUE TO RSV     | 584.9 ACUTE RENAL FAILURE, NOS  |
| 480.2                                 | PNEUMON-PARAINFLUENZA VR | 997.1 CARDIAC COMPLICATION NEC  |
| 480.3                                 | PNEUMONIA DT SARS        | 997.3 RESPIR COMPLICATIONS NEC  |
| 480.8                                 | PNEUMONIA DT VIRUS NEC   | 997.4 DIGESTIVE SYST COMPL NEC  |
| 480.9                                 | VIRAL PNEUMONIA, NOS     | 997.5 URINARY COMPLICATION NEC  |
| 481                                   | PNEUMOCOCCAL PNEUMONIA   | 998.11 HEMORRHAGE COMPLIC PROC  |
| 482                                   | OTHR BACTERIAL PNEUMONIA | 998.2 ACC PUNCTUR/LAC-PROC NEC  |
| 482.0                                 | PNEUMONIA-K. PNEUMONIAE  | 998.59 POSTOPERATIV INFECTN NEC |

| Major Complications – Hip Fracture Repair |                          |        |                           |
|---|--------------------------|--------|---------------------------|
| 410.71                                    | AMI-SUBEND INFRCT-INIT'L | 482.41 | STAPH AUREUS PNEUMONIA    |
| 427.31                                    | ATRIAL FIBRILLATION      | 482.49 | STAPH PNEUMONIA NEC       |
| 427.89                                    | CARDIAC DYSRYTHMIAS NEC  | 482.8  | PNEUMONIA-BACTERIA NEC    |
| 428.0                                     | CONGESTIVE HEART FAILURE | 482.81 | PNEUMONIA DT ANAEROBES    |
| 428.1                                     | LEFT HEART FAILURE       | 482.82 | PNEUMONIA-E. COLI         |
| 428.2                                     | SYSTOLIC HEART FAILURE   | 482.83 | PNEUMONIA-GRM NG BAC NEC  |
| 428.20                                    | SYSTOLC HEART FAILUR NOS | 482.84 | LEGIONNAIRES' DISEASE     |
| 428.21                                    | AC SYSTOLC HEART FAILURE | 482.89 | PNEUMONIA-BACTERIA NEC    |
| 428.23                                    | AC ON CHR SYSTOL HT FAIL | 482.9  | BACTERIAL PNEUMONIA, NOS  |
| 428.3                                     | DIASTOLIC HEART FAILURE  | 483    | PNEUMONIA-OTHER ORGANISM  |
| 428.30                                    | DIASTOLC HEART FAILR NOS | 483.0  | PNEUMONIA-M. PNEUMONIAE   |
| 428.31                                    | AC DIASTOL HEART FAILURE | 483.1  | PNEUMONIA DT CHLAMYDIA    |
| 428.33                                    | AC ON CHR DIASTL HT FAIL | 483.8  | PNEUMONIA DT ORGANSM NEC  |
| 428.4                                     | CMB SYST & DIAST HT FAIL | 484    | PNEUMONIA-OTH INFECT DIS  |
| 428.40                                    | CMB SYS/DIAS HT FAIL NOS | 484.1  | PNEUMONIA-CM INCLUSN DIS  |
| 428.41                                    | AC COMB SYS/DIAS HT FAIL | 484.3  | PNEUMONIA-WHOOPING COUGH  |
| 428.43                                    | AC ON CH SYS/DIA HT FAIL | 484.5  | PNEUMONIA IN ANTHRAX      |
| 428.9                                     | HEART FAILURE, NOS       | 484.6  | PNEUMONIA-ASPERGILLOSIS   |
| 480                                       | VIRAL PNEUMONIA          | 484.7  | PNEUMON-SYST MYCOSES NEC  |
| 480.0                                     | PNEUMONIA DT ADENOVIRUS  | 484.8  | PNEUMON IN INFCT DIS NEC  |
| 480.1                                     | PNEUMONIA DUE TO RSV     | 485    | BRONCHOPNEUM-ORGNISM NOS  |
| 480.2                                     | PNEUMON-PARAINFLUENZA VR | 486    | PNEUMONIA-ORGANISM NOS    |
| 480.3                                     | PNEUMONIA DT SARS        | 507.0  | PNEUMONIT-INH FOOD/VOMIT  |
| 480.8                                     | PNEUMONIA DT VIRUS NEC   | 518.0  | PULMONARY COLLAPSE        |
| 480.9                                     | VIRAL PNEUMONIA, NOS     | 518.5  | PULM INSUF PST TRAUM/SRG  |
| 481                                       | PNEUMOCOCCAL PNEUMONIA   | 518.81 | RESPIRATORY FAILURE       |
| 482                                       | OTHR BACTERIAL PNEUMONIA | 560.1  | PARALYTIC ILEUS           |
| 482.0                                     | PNEUMONIA-K. PNEUMONIAE  | 584.9  | ACUTE RENAL FAILURE, NOS  |
| 482.1                                     | PNEUMONIA DT PSEUDOMONAS | 593.9  | KIDNEY & URETER DIS NOS   |
| 482.2                                     | PNEUMONIA-H. INFLUENZAE  | 996.4  | MECH COMPL-INT ORTHO DEV  |
| 482.3                                     | PNEUMONIA-STREPTOCOCCUS  | 996.77 | COMP NEC-INTRN JT PROSTH  |
| 482.30                                    | PNEUMONIA-STREPTOCOC NOS | 996.78 | COMP NEC-ORTHO PD DEV NEC |
| 482.31                                    | PNEUMONIA-GROUP A STREP  | 997.02 | IATROGN C-VSC INFRCT/HEM  |
| 482.32                                    | PNEUMONIA-GROUP B STREP  | 997.1  | CARDIAC COMPLICATION NEC  |
| 482.39                                    | PNEUMONIA DT STREP NEC   | 997.3  | RESPIR COMPLICATIONS NEC  |
| 482.4                                     | PNEUMONIA-STAPHYLOCOCCUS | 998.11 | HEMORRHAGE COMPLIC PROC   |
| 482.40                                    | STAPH PNEUMONIA NOS      | 998.59 | POSTOPERATIV INFECTN NEC  |

| Major Complications – Partial Hip Replacement |                          |                                 |
|---|--------------------------|---------------------------------|
| 292.81  | DRUG-INDUCED DELIRIUM    | 482.40 STAPH PNEUMONIA NOS      |
| 293.0   | ACUTE DELIRIUM 4         | 482.41 STAPH AUREUS PNEUMONIA   |
| 410.71  | AMI-SUBEND INFRCT-INIT'L | 482.49 STAPH PNEUMONIA NEC      |
| 427.31  | ATRIAL FIBRILLATION      | 482.8 PNEUMONIA-BACTERIA NEC    |
| 427.89  | CARDIAC DYSRHYTHMIAS NEC | 482.81 PNEUMONIA DT ANAEROBES   |
| 428.0   | CONGESTIVE HEART FAILURE | 482.82 PNEUMONIA-E. COLI        |
| 428.1   | LEFT HEART FAILURE       | 482.83 PNEUMONIA-GRM NG BAC NEC |
| 428.2   | SYSTOLIC HEART FAILURE   | 482.84 LEGIONNAIRES' DISEASE    |
| 428.20  | SYSTOLC HEART FAILUR NOS | 482.89 PNEUMONIA-BACTERIA NEC   |
| 428.21  | AC SYSTOLC HEART FAILURE | 482.9 BACTERIAL PNEUMONIA, NOS  |
| 428.23  | AC ON CHR SYSTOL HT FAIL | 483 PNEUMONIA-OTHER ORGANISM    |
| 428.3   | DIASTOLIC HEART FAILURE  | 483.0 PNEUMONIA-M. PNEUMONIAE   |
| 428.30  | DIASTOLC HEART FAILR NOS | 483.1 PNEUMONIA DT CHLAMYDIA    |
| 428.31  | AC DIASTOL HEART FAILURE | 483.8 PNEUMONIA DT ORGANSM NEC  |
| 428.33  | AC ON CHR DIASTL HT FAIL | 484 PNEUMONIA-OTH INFECT DIS    |
| 428.4   | CMB SYST & DIAST HT FAIL | 484.1 PNEUMONIA-CM INCLUSN DIS  |
| 428.40  | CMB SYS/DIAS HT FAIL NOS | 484.3 PNEUMONIA-WHOOPING COUGH  |
| 428.41  | AC COMB SYS/DIAS HT FAIL | 484.5 PNEUMONIA IN ANTHRAX      |
| 428.43  | AC ON CH SYS/DIA HT FAIL | 484.6 PNEUMONIA-ASPERGILLOSIS   |
| 428.9   | HEART FAILURE, NOS       | 484.7 PNEUMON-SYST MYCOSES NEC  |
| 480   | VIRAL PNEUMONIA          | 484.8 PNEUMON IN INFCT DIS NEC  |
| 480.0   | PNEUMONIA DT ADENOVIRUS  | 485 BRONCHOPNEUM-ORGNISM NOS    |
| 480.1   | PNEUMONIA DUE TO RSV     | 486 PNEUMONIA-ORGANISM NOS      |
| 480.2   | PNEUMON-PARAINFLUENZA VR | 507.0 PNEUMONIT-INH FOOD/VOMIT  |
| 480.3   | PNEUMONIA DT SARS        | 518.0 PULMONARY COLLAPSE        |
| 480.8   | PNEUMONIA DT VIRUS NEC   | 518.5 PULM INSUF PST TRAUM/SRG  |
| 480.9   | VIRAL PNEUMONIA, NOS     | 518.81 RESPIRATORY FAILURE      |
| 481   | PNEUMOCOCCAL PNEUMONIA   | 560.1 PARALYTIC ILEUS           |
| 482   | OTHR BACTERIAL PNEUMONIA | 584.9 ACUTE RENAL FAILURE, NOS  |
| 482.0   | PNEUMONIA-K. PNEUMONIAE  | 593.9 KIDNEY & URETER DIS NOS   |
| 482.1   | PNEUMONIA DT PSEUDOMONAS | 996.4 MECH COMPL-INT ORTHO DEV  |
| 482.2   | PNEUMONIA-H. INFLUENZAE  | 996.77 COMP NEC-INTRN JT PROSTH |
| 482.3   | PNEUMONIA-STREPTOCOCCUS  | 996.78 COMP NEC-ORTHOPD DEV NEC |
| 482.30  | PNEUMONIA-STREPTOCOC NOS | 997.02 IATROGN C-VSC INFRCT/HEM |
| 482.31  | PNEUMONIA-GROUP A STREP  | 997.1 CARDIAC COMPLICATION NEC  |
| 482.32  | PNEUMONIA-GROUP B STREP  | 997.3 RESPIR COMPLICATIONS NEC  |
| 482.39  | PNEUMONIA DT STREP NEC   | 998.11 HEMORRHAGE COMPLIC PROC  |
| 482.4   | PNEUMONIA-STAPHYLOCOCCUS | 998.59 POSTOPERATIV INFECTN NEC |

| Major Complications – Peripheral Vascular Bypass |                           |        |                          |
|--|---------------------------|--------|--------------------------|
| 038  | SEPTICEMIA                | 481    | PNEUMOCOCCAL PNEUMONIA   |
| 038.0  | STREPTOCOCCAL SEPTICEMIA  | 482    | OTHR BACTERIAL PNEUMONIA |
| 038.1  | STAPHYLOCOCCAL SEPTICEMIA | 482.0  | PNEUMONIA-K. PNEUMONIAE  |
| 038.10   | STAPHLOCOCC SEPTICEM NOS  | 482.1  | PNEUMONIA DT PSEUDOMONAS |
| 038.11   | SEPTICEMIA-STAPH AUREUS   | 482.2  | PNEUMONIA-H. INFLUENZAE  |
| 038.19   | STAPHLOCOCC SEPTICEM NEC  | 482.3  | PNEUMONIA-STREPTOCOCCUS  |
| 038.2  | PNEUMOCOCCAL SEPTICEMIA   | 482.30 | PNEUMONIA-STREPTOCOC NOS |
| 038.3  | SEPTICEMIA DT ANAEROBES   | 482.31 | PNEUMONIA-GROUP A STREP  |
| 038.4  | SEPTICEMIA GRAM-NEGS NEC  | 482.32 | PNEUMONIA-GROUP B STREP  |
| 038.40   | SEPTICEMIA GRAM-NEGS NOS  | 482.39 | PNEUMONIA DT STREP NEC   |
| 038.41   | SEPTICEMIA-H. INFLUENZAE  | 482.4  | PNEUMONIA-STAPHYLOCOCCUS |
| 038.42   | SEPTICEMIA DT E. COLI     | 482.40 | STAPH PNEUMONIA NOS      |
| 038.43   | SEPTICEMIA - PSEUDOMONAS  | 482.41 | STAPH AUREUS PNEUMONIA   |
| 038.44   | SEPTICEMIA DT SERRATIA    | 482.49 | STAPH PNEUMONIA NEC      |
| 038.49   | SEPTICEMIA GRAM-NEG NEC   | 482.8  | PNEUMONIA-BACTERIA NEC   |
| 038.8  | OTH SPECIFIED SEPTICEMIA  | 482.81 | PNEUMONIA DT ANAEROBES   |
| 038.9  | UNSPECIFIED SEPTICEMIA    | 482.82 | PNEUMONIA-E. COLI        |
| 041.04   | BACTR INF DT GRP D STREP  | 482.83 | PNEUMONIA-GRM NG BAC NEC |
| 041.11   | BACTERL INF DT S. AUREUS  | 482.84 | LEGIONNAIRES' DISEASE    |
| 041.7  | PSEUDOMONAS IN OTHER DIS  | 482.89 | PNEUMONIA-BACTERIA NEC   |
| 427.31   | ATRIAL FIBRILLATION       | 482.9  | BACTERIAL PNEUMONIA, NOS |
| 427.89   | CARDIAC DYSRHYTHMIAS NEC  | 483    | PNEUMONIA-OTHER ORGANISM |
| 428.0  | CONGESTIVE HEART FAILURE  | 483.0  | PNEUMONIA-M. PNEUMONIAE  |
| 428.1  | LEFT HEART FAILURE        | 483.1  | PNEUMONIA DT CHLAMYDIA   |
| 428.2  | SYSTOLIC HEART FAILURE    | 483.8  | PNEUMONIA DT ORGANSM NEC |
| 428.20   | SYSTOLC HEART FAILUR NOS  | 484    | PNEUMONIA-OTH INFECT DIS |
| 428.21   | AC SYSTOLC HEART FAILURE  | 484.1  | PNEUMONIA-CM INCLUSN DIS |
| 428.23   | AC ON CHR SYSTOL HT FAIL  | 484.3  | PNEUMONIA-WHOOPING COUGH |
| 428.3  | DIASTOLIC HEART FAILURE   | 484.5  | PNEUMONIA IN ANTHRAX     |
| 428.30   | DIASTOLC HEART FAILR NOS  | 484.6  | PNEUMONIA-ASPERGILLOSIS  |
| 428.31   | AC DIASTOL HEART FAILURE  | 484.7  | PNEUMON-SYST MYCOSES NEC |
| 428.33   | AC ON CHR DIASTL HT FAIL  | 484.8  | PNEUMON IN INFCT DIS NEC |
| 428.4  | CMB SYST & DIAST HT FAIL  | 485    | BRONCHOPNEUM-ORGNISM NOS |
| 428.40   | CMB SYS/DIAS HT FAIL NOS  | 486    | PNEUMONIA-ORGANISM NOS   |
| 428.41   | AC COMB SYS/DIAS HT FAIL  | 518.5  | PULM INSUF PST TRAUM/SRG |
| 428.43   | AC ON CH SYS/DIA HT FAIL  | 584.9  | ACUTE RENAL FAILURE, NOS |
| 428.9  | HEART FAILURE, NOS        | 593.9  | KIDNEY & URETER DIS NOS  |
| 480  | VIRAL PNEUMONIA           | 996.74 | COMP NEC-VASC DEV/GRAFT  |
| 480.0  | PNEUMONIA DT ADENOVIRUS   | 997.1  | CARDIAC COMPLICATION NEC |
| 480.1  | PNEUMONIA DUE TO RSV      | 997.3  | RESPIR COMPLICATIONS NEC |
| 480.2  | PNEUMON-PARAINFLUENZA VR  | 998.11 | HEMORRHAGE COMPLIC PROC  |
| 480.3  | PNEUMONIA DT SARS         | 998.2  | ACC PUNCTUR/LAC-PROC NEC |
| 480.8  | PNEUMONIA DT VIRUS NEC    | 998.59 | POSTOPERATIV INFECTN NEC |
| 480.9  | VIRAL PNEUMONIA, NOS      |        |                          |

| Major Complications – Prostatectomy |                          |        |                          |
|-------------------------------------|--------------------------|--------|--------------------------|
| 427.31                              | ATRIAL FIBRILLATION      | 428.4  | CMB SYST & DIAST HT FAIL |
| 427.89                              | CARDIAC DYSRHYTHMIAS NEC | 428.40 | CMB SYS/DIAS HT FAIL NOS |
| 428.0                               | CONGESTIVE HEART FAILURE | 428.41 | AC COMB SYS/DIAS HT FAIL |
| 428.1                               | LEFT HEART FAILURE       | 428.43 | AC ON CH SYS/DIA HT FAIL |
| 428.2                               | SYSTOLIC HEART FAILURE   | 428.9  | HEART FAILURE, NOS       |
| 428.20                              | SYSTOLC HEART FAILUR NOS | 518.5  | PULM INSUF PST TRAUM/SRG |
| 428.21                              | AC SYSTOLC HEART FAILURE | 560.1  | PARALYTIC ILEUS          |
| 428.23                              | AC ON CHR SYSTOL HT FAIL | 584.9  | ACUTE RENAL FAILURE, NOS |
| 428.3                               | DIASTOLIC HEART FAILURE  | 997.1  | CARDIAC COMPLICATION NEC |
| 428.30                              | DIASTOLC HEART FAILR NOS | 997.4  | DIGESTIVE SYST COMPL NEC |
| 428.31                              | AC DIASTOL HEART FAILURE | 997.5  | URINARY COMPLICATION NEC |
| 428.33                              | AC ON CHR DIASTL HT FAIL | 998.11 | HEMORRHAGE COMPLIC PROC  |

| Major Complications – Total Hip Replacement |                          |                                 |
|---|--------------------------|---------------------------------|
| 427.31                                      | ATRIAL FIBRILLATION      | 428.9 HEART FAILURE, NOS        |
| 428.0                                       | CONGESTIVE HEART FAILURE | 518.0 PULMONARY COLLAPSE        |
| 428.1                                       | LEFT HEART FAILURE       | 518.5 PULM INSUF PST TRAUM/SRG  |
| 428.2                                       | SYSTOLIC HEART FAILURE   | 560.1 PARALYTIC ILEUS           |
| 428.20                                      | SYSTOLC HEART FAILUR NOS | 593.9 KIDNEY & URETER DIS NOS   |
| 428.21                                      | AC SYSTOLC HEART FAILURE | 996.4 MECH COMPL-INT ORTHO DEV  |
| 428.23                                      | AC ON CHR SYSTOL HT FAIL | 996.77 COMP NEC-INTRN JT PROSTH |
| 428.3                                       | DIASTOLIC HEART FAILURE  | 996.78 COMP NEC-ORTHOPD DEV NEC |
| 428.30                                      | DIASTOLC HEART FAILR NOS | 997.1 CARDIAC COMPLICATION NEC  |
| 428.31                                      | AC DIASTOL HEART FAILURE | 997.3 RESPIR COMPLICATIONS NEC  |
| 428.33                                      | AC ON CHR DIASTL HT FAIL | 997.4 DIGESTIVE SYST COMPL NEC  |
| 428.4                                       | CMB SYST & DIAST HT FAIL | 997.5 URINARY COMPLICATION NEC  |
| 428.40                                      | CMB SYS/DIAS HT FAIL NOS | 998.11 HEMORRHAGE COMPLIC PROC  |
| 428.41                                      | AC COMB SYS/DIAS HT FAIL | 998.59 POSTOPERATIV INFECTN NEC |
| 428.43                                      | AC ON CH SYS/DIA HT FAIL |                                 |

| Major Complications – Total Knee Replacement |                          |                                 |
|--|--------------------------|---------------------------------|
| 427.31                                       | ATRIAL FIBRILLATION      | 428.41 AC COMB SYS/DIAS HT FAIL |
| 427.89                                       | CARDIAC DYSRHYTHMIAS NEC | 428.43 AC ON CH SYS/DIA HT FAIL |
| 428.0  | CONGESTIVE HEART FAILURE | 428.9 HEART FAILURE, NOS        |
| 428.1  | LEFT HEART FAILURE       | 518.0 PULMONARY COLLAPSE        |
| 428.2  | SYSTOLIC HEART FAILURE   | 518.5 PULM INSUF PST TRAUM/SRG  |
| 428.20                                       | SYSTOLC HEART FAILUR NOS | 593.9 KIDNEY & URETER DIS NOS   |
| 428.21                                       | AC SYSTOLC HEART FAILURE | 996.4 MECH COMPL-INT ORTHO DEV  |
| 428.23                                       | AC ON CHR SYSTOL HT FAIL | 996.77 COMP NEC-INTRN JT PROSTH |
| 428.3  | DIASTOLIC HEART FAILURE  | 996.78 COMP NEC-ORTHOPD DEV NEC |
| 428.30                                       | DIASTOLC HEART FAILR NOS | 997.1 CARDIAC COMPLICATION NEC  |
| 428.31                                       | AC DIASTOL HEART FAILURE | 997.3 RESPIR COMPLICATIONS NEC  |
| 428.33                                       | AC ON CHR DIASTL HT FAIL | 997.4 DIGESTIVE SYST COMPL NEC  |
| 428.4  | CMB SYST & DIAST HT FAIL | 998.11 HEMORRHAGE COMPLIC PROC  |
| 428.40                                       | CMB SYS/DIAS HT FAIL NOS | 998.59 POSTOPERATIV INFECTN NEC |

## Appendix C: Top Five Risk Factors by Procedure or Diagnosis

Proc = Procedure Code

Diag = Diagnosis Code

|   |  |
|---|--|
| <b>Appendectomy</b>   |  |
| Diag 40.1   | AC APPENDICIT-PERIT ABSC                 |
| Diag 540.0  | AC APPENDIC-PERITONITIS                  |
| Diag 496  | CHR AIRWAY OBSTRUCT NEC                  |
| Diag 276.8  | HYPOPOTASSEMIA                           |
| Diag 038, 038.0, 038.1, 038.10, 038.11, 038.19, 038.2, 038.3, 038.4, 038.40, 038.41, 038.42, 038.43, 038.44, 038.49, 038.8, 038.9 | SEPSIS                                   |
| <b>Atrial Fibrillation</b>  |  |
| Diag 428.41   | AC COMB SYS/DIAS HT FAIL                 |
| Diag 584.9  | ACUTE RENAL FAILURE, NOS                 |
| Diag 433.01, 433.11, 433.21, 433.31, 433.81   | OCCLUSION OF CEREBRAL ARTER WITH INFARCT |
| Diag 410.31, 410.41   | INFERIOR WALL AMI                        |
| Diag 410.01, 410.11, 410.21, 410.51, 410.61, 410.81, 410.91   | ANTERIOR/LATERAL WALL AMI                |
| <b>Back and Neck Surgery (Except Spinal Fusion)</b>   |  |
| Proc 03.09  | SP CANAL EXPL/DECOMP NEC                 |
| Diag 276.1  | HYPOSMOLALITY/NATREMIA                   |
| Diag 276.8  | HYPOPOTASSEMIA                           |
| Diag 403.11, 403.91   | NON-MALIGNANT RENAL DISEASE WITH FAILURE |
| Diag 600, 600.0, 600.2, 600.20, 600.21, 600.3, 600.9, 600.90, 600.91  | HYPERPLASIA OF PROSTATE                  |
| <b>Back and Neck Surgery (Spinal Fusion)</b>  |  |
| Proc 81.04  | ANT DORSAL/DORSOLUMB FUS                 |
| Proc 81.05  | POST DORSAL/DORSOLUMB FUS                |
| Proc 81.06  | ANTERIOR LUMBAR/L-S FUSN                 |
| Proc 81.08  | POSTER'R LUMBAR/L-S FUSN                 |
| Proc 81.64  | FUSE/REFUSE >=9 VERTEBRA                 |
| <b>Bowel Obstruction</b>  |  |
| Diag 276.2  | ACIDOSIS                                 |
| Diag 428.9  | HEART FAILURE, NOS                       |
| Diag 458.9  | HYPOTENSION, UNSPECIFIED                 |
| Diag 518.81   | RESPIRATORY FAILURE                      |
| Diag 557.0  | AC VASC INSUFF-INTESTINE                 |
| <b>Carotid Endarterectomy</b>   |  |
| Proc 39.72  | ENDOASC REPR HD/NCK VES                  |
| Diag 342.90   | HEMIPLEGIA NOS-SIDE NOS                  |
| Diag 780.39   | OTHER CONVULSIONS                        |
| Diag 402.11, 402.91   | NON-MALIGNANT HYPERTENSION WITH CHF      |
| Diag 403.11, 403.91   | NON-MALIGNANT RENAL DISEASE WITH FAILURE |

|   |  |
|---|--|
| <b>Cholecystectomy</b>  |  |
| Proc 51.21  | OTH PART CHOLECYSTECTOMY                 |
| Proc 51.22  | CHOLECYSTECTOMY                          |
| Diag 493.02, 493.12, 493.22, 493.92   | ASTHMA WITH ACUTE EXACERBATION           |
| Diag 260, 261, 262, 263.0, 263.1, 263.2, 263.8, 263.9   | MALNUTRITION                             |
| Diag 038, 038.0, 038.1, 038.10, 038.11, 038.19, 038.2, 038.3, 038.4, 038.40, 038.41, 038.42, 038.43, 038.44, 038.49, 038.8, 038.9 | SEPSIS                                   |
| <b>Chronic Obstructive Pulmonary Disease (COPD)</b>   |  |
| Diag 162.9  | MAL NEOPLASM OF LUNG NOS                 |
| Diag 492.8  | OTHER EMPHYSEMA                          |
| Diag 496.   | CHR AIRWAY OBSTRUCT NEC                  |
| Diag 518.81   | RESPIRATORY FAILURE                      |
| Diag 584.5, 584.9   | ACUTE RENAL FAILURE                      |
| <b>Community Acquired Pneumonia</b>   |  |
| Diag 162.9  | MAL NEOPLASM OF LUNG NOS                 |
| Diag 276.2  | ACIDOSIS                                 |
| Diag 518.81   | RESPIRATORY FAILURE                      |
| Diag 038, 038.0, 038.1, 038.10, 038.11, 038.19, 038.2, 038.3, 038.4, 038.40, 038.41, 038.42, 038.43, 038.44, 038.49, 038.8, 038.9 | SEPSIS                                   |
| Diag 584.5, 584.9   | ACUTE RENAL FAILURE                      |
| <b>Coronary Bypass Surgery</b>  |  |
| Diag 428.9  | HEART FAILURE, NOS                       |
| Diag 584.5  | AC REN FAIL-LES TUBL NEC                 |
| Diag 584.9  | ACUTE RENAL FAILURE, NOS                 |
| Diag 433.01, 433.11, 433.21, 433.31, 433.81   | OCCLUSION OF CEREBRAL ARTER WITH INFARCT |
| Diag 441.00, 441.01, 441.02, 441.03   | DISSECTION OF AORTA                      |
| <b>Coronary Interventional Procedures</b>   |  |
| Diag 428.1  | LEFT HEART FAILURE                       |
| Diag 260, 261, 262, 263.0, 263.1, 263.2, 263.8, 263.9   | MALNUTRITION                             |
| Diag 410.31, 410.41   | INFERIOR WALL AMI                        |
| Diag 410.01, 410.11, 410.21, 410.51, 410.61, 410.81, 410.91   | ANTERIOR/LATERAL WALL AMI                |
| Diag 441.00, 441.01, 441.02, 441.03   | DISSECTION OF AORTA                      |
| <b>Diabetic Acidosis and Coma</b>   |  |
| Diag 250.30   | TYPE II DM WITH COMA NEC                 |
| Diag 250.31   | TYPE I DM WITH COMA NEC                  |
| Diag 518.81   | RESPIRATORY FAILURE                      |
| Diag 038, 038.0, 038.1, 038.10, 038.11, 038.19, 038.2, 038.3, 038.4, 038.40, 038.41, 038.42, 038.43, 038.44, 038.49, 038.8, 038.9 | SEPSIS                                   |
| Diag 410.01, 410.11, 410.21, 410.51, 410.61, 410.81, 410.91   | ANTERIOR/LATERAL WALL AMI                |
| <b>Gastrointestinal Bleed</b>   |  |
| Diag 518.81   | RESPIRATORY FAILURE                      |
| Diag 433.01, 433.11, 433.21, 433.31, 433.81   | OCCLUSION OF CEREBRAL ARTER WITH INFARCT |
| Diag 038, 038.0, 038.1, 038.10, 038.11, 038.19, 038.2, 038.3, 038.4, 038.40, 038.41, 038.42, 038.43, 038.44, 038.49, 038.8, 038.9 | SEPSIS                                   |
| Diag 410.31, 410.41   | INFERIOR WALL AMI                        |
| Diag 410.01, 410.11, 410.21, 410.51, 410.61, 410.81, 410.91   | ANTERIOR/LATERAL WALL AMI                |

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| <b>Heart Attack</b>  |  |
| Diag 276.2   | ACIDOSIS                                 |
| Diag 410.01  | AMI-ANTEROLATERL-INITIAL                 |
| Diag 410.91  | AMI-SITE NOS-INITIAL EPI                 |
| Diag 427.41  | VENTRICULAR FIBRILLATION                 |
| Diag 584.5   | AC REN FAIL-LES TUBL NEC                 |
| <b>Heart Failure</b>   |  |
| Diag 428.9   | HEART FAILURE, NOS                       |
| Diag 433.01, 433.11, 433.21, 433.31, 433.81  | OCCLUSION OF CEREBRAL ARTER WITH INFARCT |
| Diag 410.31, 410.41  | INFERIOR WALL AMI                        |
| Diag 410.01, 410.11, 410.21, 410.51, 410.61, 410.81, 410.91  | ANTERIOR/LATERAL WALL AMI                |
| Diag 584.5, 584.9  | ACUTE RENAL FAILURE                      |
| <b>Hip Fracture Repair</b>   |  |
| Proc 79.25   | OP FX RED NO INT FIX-FEM                 |
| Diag 507.0   | PNEUMONIT-INH FOOD/VOMIT                 |
| Diag 584.9   | ACUTE RENAL FAILURE, NOS                 |
| Diag 821.01  | CLOS FRACTUR-FEMUR SHAFT                 |
| Diag 260, 261, 262, 263.0, 263.1, 263.2, 263.8, 263.9  | MALNUTRITION                             |
| <b>Pancreatitis</b>  |  |
| Diag 276.2   | ACIDOSIS                                 |
| Diag 428.40  | CMB SYS/DIAS HT FAIL NOS                 |
| Diag 428.9   | HEART FAILURE, NOS                       |
| Diag 518.81  | RESPIRATORY FAILURE                      |
| Diag 038, 038.0, 038.1, 038.10, 038.11, 038.19, 038.2, 038.3, 038.4, 038.40, 038.41, 038.42, 038.43, 038.44, 038.49, 038.8, 038.9  | SEPSIS                                   |
| <b>Partial Hip Replacement</b>   |  |
| Diag 491.21  | OBST CHR BRONCH-AC EXACR                 |
| Diag 507.0   | PNEUMONIT-INH FOOD/VOMIT                 |
| Diag 584.9   | ACUTE RENAL FAILURE, NOS                 |
| Diag 733.82  | NONUNION OF FRACTURE                     |
| Diag 493.02, 493.12, 493.22, 493.92  | ASTHMA WITH ACUTE EXACERBATION           |
| <b>Peripheral Vascular Bypass</b>  |  |
| Diag 428.31  | AC DIASTOL HEART FAILURE                 |
| Diag 453.8   | EMBOLI/THROMBO-VEIN NEC                  |
| Diag 682.6   | CELLULITIS/ABSCSS OF LEG                 |
| Diag 480, 480.0, 480.1, 480.2, 480.3, 480.8, 480.9, 481, 482, 482.0, 482.1, 482.2, 482.3, 482.30, 482.31, 482.32, 482.39, 482.4, 482.40, 482.41, 482.49, 482.8, 482.81, 482.82, 482.83, 482.84, 482.89, 482.9, 483, 483.0, 483.1, 483.8, 484, 484.1, 484.3, 484.5, 484.6, 484.7, 484.8, 485, 486 | PNEUMONIA                                |
| Diag 584.5, 584.9  | ACUTE RENAL FAILURE                      |
| <b>Prostatectomy</b>   |  |
| Diag 276.1   | HYPOSMOLALITY/NATREMIA                   |
| Diag 276.8   | HYPOPOTASSEMIA                           |
| Diag 788.21  | INCOMPLET BLADDR EMPTYNG                 |
| Diag 788.29  | RETENTION OF URINE, NEC                  |
| Diag 584.5, 584.9  | ACUTE RENAL FAILURE                      |



|   |  |
|---|--|
| <b>Pulmonary Embolism</b>                                   |  |
| Diag 276.2  | ACIDOSIS                                 |
| Diag 428.9  | HEART FAILURE, NOS                       |
| Diag 458.9  | HYPOTENSION, UNSPECIFIED                 |
| Diag 518.81   | RESPIRATORY FAILURE                      |
| Diag 433.01, 433.11, 433.21, 433.31, 433.81                 | OCCLUSION OF CEREBRAL ARTER WITH INFARCT |
| <b>Resection/Replacement of Abdominal Aorta</b>             |  |
| Proc 38.64  | EXCISION NEC-ABD AORTA                   |
| Diag 441.3  | ABDOMINAL ANEURYSM-RUPTR                 |
| Diag 557.0  | AC VASC INSUFF-INTESTINE                 |
| Diag 785.59   | SHOCK NEC-NO MENT TRAUMA                 |
| Diag 410.01, 410.11, 410.21, 410.51, 410.61, 410.81, 410.91 | ANTERIOR/LATERAL WALL AMI                |
| <b>Sepsis</b>   |  |
| Diag 197.7  | 2NDRY MAL NEOPLASM-LIVER                 |
| Diag 428.9  | HEART FAILURE, NOS                       |
| Diag 518.81   | RESPIRATORY FAILURE                      |
| Diag 785.59   | SHOCK NEC-NO MENT TRAUMA                 |
| Diag 410.01, 410.11, 410.21, 410.51, 410.61, 410.81, 410.91 | ANTERIOR/LATERAL WALL AMI                |
| <b>Stroke</b>   |  |
| Diag 430.   | SUBARACHNOID HEMORRHAGE                  |
| Diag 431.   | INTRACEREBRAL HEMORRHAGE                 |
| Diag 518.81   | RESPIRATORY FAILURE                      |
| Diag 780.01   | COMA                                     |
| Diag 410.01, 410.11, 410.21, 410.51, 410.61, 410.81, 410.91 | ANTERIOR/LATERAL WALL AMI                |
| <b>Total Hip Replacement</b>                                |  |
| Diag 276.1  | HYPOSOLALITY/NATREMIA                    |
| Diag 276.5  | VOLUME DEPLETION                         |
| Diag 427.89   | CARDIAC DYSRYTHMIAS NEC                  |
| Diag 403.11, 403.91   | NON-MALIGNANT RENAL DISEASE WITH FAILURE |
| Diag 81.51  | BILATERAL HIP                            |
| <b>Total Knee Replacement</b>                               |  |
| Diag 402.11, 402.91   | NON-MALIGNANT HYPERTENSION WITH CHF      |
| Diag 403.11, 403.91   | NON-MALIGNANT RENAL DISEASE WITH FAILURE |
| Diag 404.11, 404.91   | NON-MALIG HYPERTEN & REN WITH CHF        |
| Diag 493.02, 493.12, 493.22, 493.92                         | ASTHMA WITH ACUTE EXACERBATION           |
| Diag 260, 261, 262, 263.0, 263.1, 263.2, 263.8, 263.9       | MALNUTRITION                             |
| <b>Valve Replacement Surgery</b>                            |  |
| Diag 428.1  | LEFT HEART FAILURE                       |
| Diag 428.9  | HEART FAILURE, NOS                       |
| Diag 584.5  | AC REN FAIL-LES TUBL NEC                 |
| Diag 584.9  | ACUTE RENAL FAILURE, NOS                 |
| Diag 410.01, 410.11, 410.21, 410.51, 410.61, 410.81, 410.91 | ANTERIOR/LATERAL WALL AMI                |

## Appendix D: Methodology Enhancements for 2006 Ratings Models

The following changes were determined and implemented after input from outside coding and clinical experts. For the following service lines, we describe the changes for each rated cohort and provide the rationale behind these changes.

- All Service Lines
- Cardiac
- Critical Care
- Orthopedic
- Pulmonary
- Vascular

### All Service Lines

| Cohorts Affected  | 2006 Ratings' Model Change   | Rationale for Changes   |
|---|--|---|
| All   | Combined 584.5 and 584.9 into "Acute Renal Failure" when assessing as a risk factor or comorbid. | To minimize the effect of coding variations, codes were combined that were clinically similar.                          |
| All   | Removed "complication of medical care, NEC" (998.89) as a major complication.                    | Determined this code most often represented "post-operative fever" which was determined to not be a major complication. |
| All diagnosis cohorts, hip fracture repair, partial hip replacement | Excluded "encounter for palliative care" (V66.7) patients from cohort ratings analysis.          | This code was found to represent 1% or more of these cohorts and given their certain mortality, they were excluded.     |

### Cardiac

| Cohorts Affected   | 2006 Ratings' Model Change  | Rationale for Changes   |
|--|---|---|
| Coronary Artery Bypass Graft<br>Coronary Interventional Procedures<br>Heart Attack | Removed cardiogenic shock (785.51), cardiac arrest (427.5) and anoxic brain (348.1) injury as risk factors.   | After extensive analysis and benchmarking with data bases that have present on admission indicators (ex. California's OSHPD), it still remained unclear as to whether these were present on admission or a post-operative complication. As such, we developed models using all the other diagnosis codes that are known to be present on admission with these complicated patients. (C-statistics remained similar with and without these 3 diagnoses as predictors.) |
| Coronary Artery Bypass Graft<br>Valve Surgery                                      | Combined all anterior wall-related AMI codes (410.01, 410.11, 410.21, 410.51, 410.61, and 410.81) as one potential risk factor. Combined all inferior wall-related AMI codes (410.31, 410.41) as another potential risk factor. | To minimize the effect of coding variations, codes were combined that were clinically similar. Also, to address the low volumes associated with some of these individual diagnosis codes, clinically similar codes were combined to achieve statistical significance and remain in the final prediction model.  |
| Coronary Artery Bypass Graft Surgery   | Excluded all valve repairs (35.10 – 35.14).   | This situation is very rare, but when it does occur, inadequate risk adjustment may occur due to the low volume of this patient population (and not reaching the statistical significance required to remain in the final prediction model), thus necessitating exclusion from the patient population evaluated.  |
| Valve Surgery  | Included combined codes for "other valve repair" (35.10, 35.11, 35.13, 35.14) and "mitral repair" (35.12) as potential (positive or negative) predictors of mortality.  | Although rates of valve repairs are increasing across several institutions, there are still insufficient numbers associated with each valve repair procedure code to reach statistical significance. As such, like valve repair codes were combined to increase the likelihood of reaching statistical significance and be included in the final prediction model.  |
| Coronary Interventions   | Excluded patients who also received a Coronary Artery Bypass Graft (CABG) Surgery Valve Replacement, or Valve Repair in the same hospitalization.   | With few exceptions, CABG is the main, and usually final, procedure in admissions where PCI and CABG are performed in the same hospitalization. Deaths that occur are most likely related to the CABG and should thus be linked only to this procedure (not to PCI).  |

**Cardiac (continued)**

| Cohorts Affected                           | 2006 Ratings' Model Change  | Rationale for Changes   |
|--|---|---|
| Acute Myocardial Infarction (Heart Attack) | Included CABG and PCI procedures (using the codes that define each of these cohorts, which can be found in Appendix A) as potential (positive or negative) predictors of mortality. | CABG and PCI can improve AMI outcomes. These are negative predictors of mortality ("protective benefit") and should be included to adequately risk adjust and differentiate the intervention patients from the medical management only patients.  |
| Heart Failure                              | Excluded patients who received dialysis in the same hospitalization (39.95).  | Dialysis patients often present in "fluid overload" from missed dialysis. In addition, "fluid overload" is not well differentiated from congestive heart failure, potentially resulting in a skewed population of highly complex patients (compared to the national average) for some hospitals with high rates of dialysis patients. |

**Critical Care**

| Cohorts Affected           | 2006 Ratings' Model Change  | Rationale for Changes   |
|----------------------------|---|---|
| Diabetic Acidosis and Coma | New cohort rating added 2006. Only in-hospital and 30 day risk-adjusted mortality was rated. 180 day mortality was not rated. | Broaden the hospitals' Critical Care service line quality assessment for users. |
| Sepsis                     | Removed 771.81, 785.59, 995.93, and 995.94 from the cohort definition.  | Removed based on recommendation of coders.                                      |

**Orthopedic**

| Cohorts Affected                       | 2006 Ratings' Model Change   | Rationale for Changes  |
|--|--|--|
| Primary Total Knee and Hip Replacement | Excluded patient with "removal of hardware" procedure codes (78.65, 78.67, 80.05, and 80.06).          | Few patients who receive a primary joint replacement also get previous joint implants removed from a contralateral joint in the same hospitalization. This "failed hardware" is coded as a complication of the joint prosthesis or mechanical failure of the device in the secondary diagnoses field, which would appear to be a major post-operative complication of the primary joint replacement. Therefore, we identified the hardware removal procedure codes and excluded these patients from the Primary Total Knee and Hip Replacement analysis. |
| Primary Total Knee and Hip Replacement | Removed Deep Vein Thrombosis (458.9) as a major complication.  | Deep Vein Thrombosis (DVT) is an important complication. Appropriate DVT prophylaxis is the only known effective prevention and is the standard of care in joint replacement patients. Sometimes however, despite adequate prophylaxis, DVTs will still develop. As such, any DVT that does occur post-operatively in primary joint replacement surgery patients is unlikely preventable and should not be used as a quality measure.  |
| Primary Total Knee and Hip Replacement | Excluded patients from primary total knee replacement who also had a primary total hip and vice-versa. | This situation is very rare, but when it does occur, inadequate risk adjustment may occur due to the low volume of this patient population (and not reaching the statistical significance required to remain in the final prediction model), thus necessitating exclusion from the patient population evaluated.   |
| Primary Total Knee and Hip Replacement | Excluded patients who also had a partial hip replacement (81.51, 81.52) in the same hospitalization.   | Partial hip replacement overwhelmingly occurs as the principal procedure. However, when it does occur as a secondary procedure associated with Primary Total Knee or Hip Replacement, inadequate risk adjustment may occur due to the low volume of this patient population (and not reaching the statistical significance required to remain in the final prediction model), thus requiring exclusion from the patient population evaluated.  |

**Orthopedic (continued)**

| Cohorts Affected             | 2006 Ratings' Model Change  | Rationale for Changes  |
|------------------------------|---|--|
| Partial Hip and Hip Fracture | Removed patients with open fractures. (820.10, 820.11, 820.12, 820.13, 820.19, 820.30, 820.31, 820.32, 820.9, 821.11, 821.30, 821.31, 821.32, 821.33, 821.39) | This situation is very rare, but when it does occur, inadequate risk adjustment may occur due to the low volume of this patient population (and not reaching the statistical significance required to remain in the final prediction model), thus necessitating exclusion from the patient population evaluated. |

**Pulmonary**

| Cohorts Affected     | 2006 Ratings' Model Change | Rationale for Changes   |
|----------------------|----------------------------|---|
| Aspiration Pneumonia | No longer rated.           | Identified inconsistencies in coding aspiration pneumonia as final principal diagnosis. |

**Vascular**

| Cohorts Affected   | 2006 Ratings' Model Change  | Rationale for Changes   |
|--|---|---|
| Carotid Endarterectomy<br>Abdominal Aortic Aneurysm Repair<br>Peripheral Vascular Bypass | The patients evaluated in these cohort ratings had one of these procedures as their principal procedure.  | These procedures overwhelmingly occur as the principal procedure. When it occurs in the secondary position, inadequate risk adjustment may occur due to the low volume of this patient population (and not reaching the statistical significance required to remain in the final prediction model), thus requiring exclusion from the patient population evaluated.                         |
| Carotid Endarterectomy   | Excluded carotid stents (39.90).  | Extremely low volume prohibited achieving the statistical significance required to remain in the final prediction model. This rare group also can represent the sickest, most frail population and be possibly under risk adjusted.   |
| Abdominal Aortic Aneurysm Repair   | Excluded aortic dissections (441.00 – 441.03), non-abdominal aneurysms (441.1, 441.2, 441.6, 441.7, 441.9) resection of thoracic vessel with replacement (38.45), and valve repairs (35.10 – 35.14) and replacements (35.20 – 35.28). | These codes are infrequently associated with AAA, but when they do occur, inadequate risk adjustment may occur due to the low volume of this patient population (and not reaching the statistical significance required to remain in the final prediction model), thus necessitating exclusion from the patient population evaluated.   |
| Abdominal Aortic Aneurysm Repair   | Respiratory failure (518.81) was not used as a predictor of mortality.  | After extensive analysis and benchmarking with data bases that have present on admission indicators (e.g., California's OSHPD), it still remained unclear as to when this is present on admission and when it is a post-operative complication. As such, we developed models using all the other diagnosis codes that are known to be present on admission with these complicated patients. |