Appendix A: Description of ICD9 Codes used to define etiologies, complications and procedures

| Etiology         | ICD9 Codes                                      | % of Decompensated Cirrhosis Group | % of Compensated Cirrhosis Group |
|------------------|-------------------------------------------------|------------------------------------|----------------------------------|
| Hepatitis C      | 070.41, 070.44, 070.51, 070.54, 070.70, 070.71, V0262 | 28.20%                             | 33.28%                           |
| ALD              | 571.0, 571.1, 571.11, 571.3                     | 51.24%                             | 37.40%                           |
| Hepatitis B      | 070.20, 070.21, 070.22, 070.23, 070.30, 070.31, 070.32, 070.33, V0261 | 2.75%                              | 3.10%                            |
| NOS              | 571.40, 571.41, 571.49, 571.5, 571.9             | 26.07%                             | 31.57%                           |
| Other            | 571.42, 571.6, 576.1, 275.1, 275.0, 275.01, 273.4, 571.8 | 48.62%                             | 60.27%                           |

| Procedures       | ICD9 Codes                                      | % of Decompensated Cirrhosis Group | % of Compensated Cirrhosis Group |
|------------------|-------------------------------------------------|------------------------------------|----------------------------------|
| Liver Biopsy     | 50.11, 50.12, 50.13                             | 2.19%                              | 2.20%                            |
| Upper Gastrointestinal endoscopy | 45.13, 45.14, 45.16, 42.23, 42.24, 44.13, 44.14 | 17.20%                             | 6.72%                            |
| Variceal Ligation and/or sclerotherapy | 42.91, 42.33                                    | 8.39%                              | 0.36%                            |
| Insertion of Sengstaken tube /esophageal tamponade | 96.06                                           | 0.06%                              | 0%                               |
| Paracentesis     | 54.91                                           | 31.85%                             | 2.29%                            |
| Thoracentesis    | 34.91, 34.04, 34.09                             | 3.61%                              | 2.27%                            |
| Transjugular Intrahepatic Portosystemic shunt | 39.1                                            | 1.52%                              | 0.01%                            |
| Mechanical ventilation beyond 96 hours | 96.71, 96.70, 96.72                             | 6.45%                              | 4.12%                            |
| Hemodialysis     | 39.55                                           | 5.08%                              | 4.03%                            |
| Orthotopic Liver Transplant | 50.5                                            | 0%                                 | 0%                               |
| Red Blood Cell Transfusion | 99.04                                          | 24.13%                             | 11.52%                           |
| Platelets Transfusion | 99.05                                          | 5.73%                              | 2.88%                            |
| FFP Transfusion  | 99.07                                           | 9.76%                              | 3.10%                            |

| Procedure Group (Included in Regression Analysis) | ICD9 Codes                                      | % of Decompensated Cirrhosis Group | % of Compensated Cirrhosis Group |
|---------------------------------------------------|-------------------------------------------------|------------------------------------|----------------------------------|
| Varices Treatment                                 | Includes Upper Gastrointestinal endoscopy, Variceal Ligation and/or sclerotherapy and Insertion of Sengstaken tube /esophageal tamponade | 24.03%                             | 6.98%                            |
| Fluid Removal                                     | Includes Paracentesis and Thoracentesis        | 34.20%                             | 4.44%                            |
| Non-RBC Transfuse                                | Includes Platelets Transfusion and FFP Transfusion | 12.66%                             | 4.99%                            |

| Complications | ICD9 Codes                                      | % of Decompensated Cirrhosis Group | % of Compensated Cirrhosis Group |
|---------------|-------------------------------------------------|------------------------------------|----------------------------------|
| Portal Hypertension | 572.3, 789.59, 289.53, 289.51, 287.4, 287.49, 287.5, 456.0, 456.20, 456.1, 456.21, 456.8, 455.0 | 89.15%                             | 27.74%                           |
| Ascites       | 789.59                                          | 56.97%                             | 0%                               |
| Splenomegaly  | 289.53, 289.51                                  | 0.40%                              | 0.20%                            |
| Thrombocytopenia | 287.4, 287.49, 287.5                           | 28.65%                             | 22.52%                           |
| Hyponatremia  | 276.1                                           | 19.54%                             | 12.37%                           |
| Condition                                | ICD-10 Codes                               | Frequency | Mortality |
|------------------------------------------|--------------------------------------------|-----------|-----------|
| Varices with Bleeding                    | 456.0, 456.20                              | 10.53%    | 0%        |
| Varices without Bleeding                 | 456.1, 456.21, 456.8, 455.0                | 22.37%    | 7.32%     |
| Non-PHTN GI Bleeding                     | 535.31, 569.3, 578.0, 455.2, 455.5, 455.4, 455.1, 455.6, 459.0, 287.8, 285.1, 280.0 | 25.08%    | 7.53%     |
| Spontaneous bacterial peritonitis         | 567.23                                     | 4.04%     | 0.59%     |
| Hepatorenal syndrome                     | 572.4                                      | 5.82%     | 0%        |
| Hepatic Encephalopathy                   | 348.31, 348.30, 348.39, 572.2              | 32.38%    | 3.58%     |
| Malnutrition                             | 273.8, 262.0, 263.0, 783.21, 783.7         | 5.46%     | 3.86%     |
| Hepatocellular Carcinoma                 | 155.0                                      | 5.28%     | 4.38%     |
| Hepatopulmonary Syndrome                 | 573.5                                      | 0.13%     | 0.07%     |
| Acute Renal Injury                       | 584.9, 584.6, 584.7                        | 20.19%    | 12.46%    |
| Infection                                | 590.10, 590.11, 595.0, 597.0, 599.0, 590.80, 590.81, 008.45, 112.2x, 590.2x, 590.3x, 480.x-485.x, 487.x, 488.x, 680.x-682.x, 684.x, 686.x | 18.73%    | 20.23%    |
## Appendix B: Primary Diagnosis Codes by organ system in each study group

| Diagnosis                          | DC Group | CC Group | NIS without cirrhosis |
|------------------------------------|----------|----------|-----------------------|
|                                    | ICD-9 Code | Prevalence (%) | ICD-9 Code | Prevalence (%) | ICD-9 Code | Prevalence (%) |
| Liver                              |          |          |          |          |          |          |
| Cirrhosis                          | 571.2, 571.5 | 25.1     | 571.2, 571.5 | 4.5    |
| Viral Hepatitis                    | 70.44, 70.71 | 4.6      | 70.71, 70.44 | 3.8    |
| Alcoholic CLD                      | 571.1    | 1.0      |          |          |          |          |
| Other CLD                          | 572.8    | 1.5      |          |          |          |          |
| Primary Liver Cancers              | 155.0   | 1.6      | 155.0    | 1.6    |
| Varices w or w/o bleeding          | 578.0   | 1.8      |          |          |          |          |
| Portal HTN                         |          |          |          |          |          |          |
| Ascites                            | 789.59  | 1.2      |          |          |          |          |
| Encephalopathy                     | 572.2   | 12.9     |          |          |          |          |
| Hepatorenal Syndrome               |          |          |          |          |          |          |
| Hepatopulmonary syndrome           |          |          |          |          |          |          |
| Thrombocytopenia                   |          |          |          |          |          |          |
| SBP                                | 567.23  | 1.4      |          |          |          |          |
| Complication liver transplant      |          |          |          |          |          |          |
| Complication liver biopsy          |          |          |          |          |          |          |
| Pleural Effusion                   | 511.9   | 1.0      |          |          |          |          |
| Cardiovascular                     |          |          |          |          |          |          |
| Congestive Heart Failure           | 428.0   | 1.5      | 428.0    | 3.0    | 428.0    | 2.8    |
| Arrhythmia                         | 427.31  | 1.4      | 427.31   | 2.2    |
| MI/CAD (atherosclerosis)           | 414.01  | 1.5      | 414.01, 410.71 | 4.3 |
| Other Cardiac (Chest pain, HTN, aneurysm, syncope) | 786.59 | 2.3 | 786.59 | 3.3 |
| Pulmonary                          |          |          |          |          |          |          |
| Asthma, COPD                       | 493.22  | 1.2      | 493.22   | 1.4    |
| Respiratory failure                | 518.81  | 1.1      | 518.81   | 1.1    |
| Pulmonary Embolism                 |          |          |          |          |          | 415.9   | 1.0    |
| Medical Condition | ICD Codes | Prevalence | Prevalence | Prevalence | Prevalence |
|-------------------|-----------|------------|------------|------------|------------|
| **Gastrointestinal** |           |            |            |            |            |
| GI bleed (non-portal hypertensive) | 578.9 | 6.2 | 531.40 | 2.8 | 578.9 | 1.0 |
| Other GI (Abdominal pain, Pancreatitis, biliary system, hemorrhoids, small bowel obstruction, diverticulosis, appendicitis) | 577.0 | 4.1 | 577.0 | 8.3 | 577.0 | 5.0 |
| **Infections** |           |            |            |            |            |
| Pneumonia | 486.x | 1.6 | 486.x, 491.21 | 4.4 | 486.x, 491.21 | 4.6 |
| Urinary Tract Infection | 599.0, 590.80, 590.10 | 1.5 | 599.0 | 1.6 |          |          |
| Septicemia | 03.89 | 3.7 | 03.89 | 3.7 | 03.89 | 2.2 |
| Other Infections (cellulitis, colitis, HIV, abscess, endocarditis, Gangrene, venous insufficiency of legs) | 682.6 | 1.6 | 682.6 | 4.9 | 682.6 | 2.8 |
| **Renal** |           |            |            |            |            |
| Acute Renal Failure | 584.9 | 2.0 | 584.9 | 1.9 | 584.9 | 1.2 |
| Electrolytes abnormalities (including hyponatremia) | 276.1 | 1.1 | 276.1 | 2.0 |          |          |
| **Psychiatry** |           |            |            |            |            |
| Alcohol-related disorders (withdrawal, alcohol-related delirium, alcoholic intoxication, alcohol dependence) | 291.81 | 4.0 |          |          |          |          |
| Mood disorders | 296.33 | 1.8 | 295.70 | 3.3 |          |          |
| **Nervous system** |           |            |            |            |            |
| Stroke/TIA | 434.91 | 1.2 | 434.91 | 1.7 |          |          |
| Other Nervous system (Dementia, Alzheimer’s, Syncope) | 780.2 | 1.4 | 780.2 | 1.9 |          |          |
| **Hematology/Oncology** |           |            |            |            |            |
| Anemia | 285.9 | 1.3 |          |          |          |          |
| **Obstetrics-Gynecology** |           |            |            |            |            |
| Pregnancy related Complications | 654.21, 664.11 | 9.2 |          |          |          |          |
| **Other** |           |            |            |            |            |
| Endocrine – Diabetes Mellitus, Morbid Obesity | 250.80 | 1.9 | 278.01 | 1.5 |          |          |
| Musculoskeletal – Rehabilitation care, Arthritis, Fractures | V57.89 | 2.9 | 715.36, V57.89 | 6.6 |          |          |

*ICD 9 Codes listed in the DX1 position in years 2008-2011 were included for analysis if prevalence ≥ 0.1%. Codes were grouped based on organ system and clinical disease state through manual review. Groups of codes with ≥ 1% prevalence in dataset are listed.

‡Only ICD9 codes with ≥ 1% prevalence are listed; if a group had no individual code ≥ 1% in a category, the code with highest prevalence is listed.
Appendix C: Description of classes of Co-morbidities

| Comorbidity Class | Comorbidity Indicator Variables | % of Decompensated Cirrhosis | % of compensated cirrhosis | % of All NIS w/o cirrhosis |
|-------------------|---------------------------------|------------------------------|-----------------------------|---------------------------|
| Heart             | Congestive Heart Failure        | 8.99%                        | 10.32%                      | 7.79%                     |
| Heart             | Valvular Disease                | 2.60%                        | 3.17%                       | 2.94%                     |
| Heart             | Pulmonary Circulation Disease   | 2.66%                        | 2.77%                       | 1.74%                     |
| Heart             | Peripheral Vascular Disease     | 2.70%                        | 4.47%                       | 5.01%                     |
| Hypertension      | Hypertension                    | 38.56%                       | 49.98%                      | 46.61%                    |
| NeuroPara         | Paralysis                       | 0.86%                        | 1.58%                       | 2.32%                     |
| NeuroPara         | Other Neurological Disorders    | 5.88%                        | 8.26%                       | 6.80%                     |
| Chronic Lung      | Chronic Pulmonary Disease       | 14.86%                       | 22.11%                      | 16.93%                    |
| Diabetes          | Diabetes without Complications  | 25.17%                       | 26.65%                      | 17.70%                    |
| Diabetes          | Diabetes with Complications     | 4.71%                        | 5.71%                       | 4.06%                     |
| NI in Regression †| Hypothyroidism                  | 8.84%                        | 10.68%                      | 10.18%                    |
| LytesRenl         | Renal Failure                   | 15.94%                       | 13.40%                      | 10.36%                    |
| NI in Regression †| Liver Disease                   | 55.07%                       | 89.74%                      | 1.51%                     |
| NI in Regression †| Peptic Ulcer Disease x Bleeding| 0.07%                        | 0.06%                       | 0.03%                     |
| NI in Regression †| Acquired Immunodeficiency Syndrome | 0.67%                     | 0.90%                       | 0.23%                     |
| Cancer            | Lymphoma                        | 0.64%                        | 0.74%                       | 0.75%                     |
| Cancer            | Metastatic Cancer               | 1.48%                        | 1.89%                       | 2.12%                     |
| Cancer            | Solid Tumor without Metastasis  | 4.63%                        | 3.73%                       | 1.88%                     |
| NI in Regression †| Rheumatoid Arthritis/Collagen vascular disease | 1.57%                     | 2.63%                       | 2.42%                     |
| NI in Regression †| Coagulopathy                    | 37.51%                       | 25.53%                      | 3.56%                     |
| NI in Regression †| Obesity                         | 6.94%                        | 9.09%                       | 9.95%                     |
| NI in Regression †| Weight Loss                     | 11.18%                       | 7.05%                       | 4.00%                     |
| LytesRenl         | Fluid & Electrolyte Disorders   | 42.64%                       | 32.67%                      | 20.74%                    |
| Anemia            | Chronic Blood Loss Anemia       | 4.10%                        | 1.42%                       | 2.33%                     |
| Anemia            | Deficiency Anemias              | 27.08%                       | 22.19%                      | 14.73%                    |
| AlcDrug           | Alcohol Abuse                   | 40.32%                       | 31.25%                      | 3.75%                     |
| AlcDrug           | Drug Abuse                      | 6.11%                        | 8.89%                       | 3.91%                     |
| Mental            | Psychoses                       | 4.58%                        | 7.04%                       | 4.23%                     |
| Mental            | Depression                      | 8.87%                        | 12.22%                      | 9.44%                     |

†These comorbidities were not included in regression analysis.
### Supplement D: Specific Outcome Measures by Group with Pregnancy Excluded

| Outcome Variable                              | Decompensated Cirrhosis | Compensated Cirrhosis | All NIS w/o cirrhosis | NIS w/o cirrhosis and pregnancy complication* |
|------------------------------------------------|--------------------------|-----------------------|-----------------------|-----------------------------------------------|
| No. of admissions (2014)                      | 334,370.1                | 236,360.1             | 29,181,233.8          | 26,116,013.8                                  |
| Percentage Increase in no. of admissions       | 35.89%                   | 24.22%                | -7.72%                | -7.73%                                        |
| Total cost of hospitalization (2014)           | $4,570,431,130           | $2,801,813,569        | $333,194,350,525      | $319,834,050,612                              |
| Percentage Increase in total cost of admissions| 33.4%                    | 25.33%                | 3.98%                 | 3.93%                                         |
| Median Cost per Admission (IQR) †             | $8,596 ($9,633)          | $7,738 ($8,998)       | $7,141 ($9,137)       | $7,869.55                                     |
| Medicare (IQR) †                               | $8,618 ($9,586)          | $7,922 ($9,028)       | $8,183 ($9,714)       | $8,193.11                                     |
| Medicaid (IQR) †                               | $8,801 ($10,568)         | $7,266 ($8,625)       | $5,073 ($6,023)       | $6,192.40                                     |
| Private Pay (IQR) †                            | $9,086 ($11,179)         | $7,962 ($9,881)       | $6,535 ($8,651)       | $7,724.98                                     |
| Median Length of Stay (Q1-Q3)                  | 4 (2-7)                  | 4 (2-6)               | 3 (2-5)               | 3 (2-6)                                       |
| In-hospital Mortality‡                         | 6.66%                    | 3.37%                 | 2.13%                 | 2.38%                                         |

*Admissions where primary diagnosis was pregnancy or its complications were excluded.
†Median cost calculated for all years (2008-2014) combined and adjusted to 2014 dollars. IQR = Interquartile Range
‡Percent died prior to discharge
## Supplement E: Demographics of patients admitted 2008-2014 with pregnancy excluded†

| Discharge and hospital characteristics | % of Decompensated Cirrhosis | % of Compensated cirrhosis | % of All NIS w/o cirrhosis | NIS w/o cirrhosis and pregnancy complication* |
|----------------------------------------|-----------------------------|---------------------------|---------------------------|-----------------------------------------------|
| **Mean Age, years (SD)**               | 58.3 (12.1)                 | 59.3 (12.6)               | 57.2 (20.8)               | 60.5 (19.3)                                  |
| 18-44                                  | 10.5%                       | 9.9%                      | 29.8%                     | 21.9%                                        |
| 45-64                                  | 61.4%                       | 58.7%                     | 28.7%                     | 31.9%                                        |
| 65-84                                  | 26.0%                       | 28.5%                     | 31.8%                     | 35.4%                                        |
| 85+                                    | 2.1%                        | 2.9%                      | 9.7%                      | 10.8%                                        |
| Male                                   | 62.5%                       | 58.9%                     | 40.1%                     | 44.6%                                        |
| **Race**                               |                             |                           |                           |                                               |
| White                                  | 60.6%                       | 60.6%                     | 61.7%                     | 63.4%                                        |
| Black                                  | 8.8%                        | 11.4%                     | 13.1%                     | 13.1%                                        |
| Hispanic                               | 16.7%                       | 14.4%                     | 9.3%                      | 8.1%                                         |
| Asian or Pacific Islander              | 1.8%                        | 1.8%                      | 2.2%                      | 1.9%                                         |
| Native American                        | 1.3%                        | 1.1%                      | 0.6%                      | 0.6%                                         |
| Other                                  | 2.9%                        | 2.7%                      | 2.8%                      | 2.6%                                         |
| Missing                                | 7.9%                        | 7.9%                      | 10.4%                     | 10.3%                                        |
| **Median Income by Patient Zip Code‡** |                             |                           |                           |                                               |
| Quartile 1 (lowest income)            | 31.8%                       | 33.3%                     | 28.5%                     | 28.7%                                        |
| Quartile 2                             | 25.7%                       | 25.4%                     | 25.7%                     | 25.7%                                        |
| Quartile 3                             | 22.3%                       | 21.5%                     | 23.2%                     | 23.1%                                        |
| Quartile 4 (highest income)           | 16.9%                       | 16.1%                     | 20.2%                     | 20.0%                                        |
| **Admissions by Payer Type**           |                             |                           |                           |                                               |
| Medicare                               | 41.3%                       | 46.3%                     | 45.5%                     | 50.1%                                        |
| Medicaid                               | 23.0%                       | 22.1%                     | 15.5%                     | 12.4%                                        |
| Private/HMO                            | 22.3%                       | 19.7%                     | 29.7%                     | 27.3%                                        |
| Other                                  | 13.2%                       | 11.6%                     | 9.1%                      | 5.9%                                         |
| **Origin of Admission**                |                             |                           |                           |                                               |
| Emergency Department                   | 74.2%                       | 69.5%                     | 53.5%                     | 58.7%                                        |
| Transfer                               | 6.8%                        | 5.3%                      | 4.9%                      | 5.3%                                         |
| **Disposition of Patient**             |                             |                           |                           |                                               |
| Home                                   | 58.3%                       | 61.9%                     | 66.8%                     | 63.3%                                        |
| Transfer to another hospital           | 3.8%                        | 2.8%                      | 2.1%                      | 2.3%                                         |
| Transfer to SNF, intermediate care or another facility | 15.5% | 16.2% | 15.6% | 17.4% |
| Home Health Care                       | 13.4%                       | 13.0%                     | 12.1%                     | 13.3%                                        |
| Teaching Hospital§                     | 54.5%                       | 53.2%                     | 49.2%                     | 51.0%                                        |
| Rural Hospital§                        | 8.8%                        | 9.7%                      | 11.9%                     | 12.0%                                        |
| **Hospital Region¶**                   |                             |                           |                           |                                               |
| Northeast                              | 18.5%                       | 20.0%                     | 19.6%                     | 20.0%                                        |
| Midwest                                | 18.9%                       | 18.6%                     | 23.0%                     | 23.2%                                        |
| South                                  | 38.9%                       | 39%                       | 38.5%                     | 38.6%                                        |
| West                                   | 23.8%                       | 22.5%                     | 18.8%                     | 18.1%                                        |

*Admissions where primary diagnosis was pregnancy or its complications were excluded.
†Mean and proportions presents in the table are weighted as per NIS discharges
‡Income by zip code included in each quartile varies by year. For dollar amounts included in each quartile each year, refer to [http://www.hcup-us.ahrq.gov/db/vars/zipinc_qrtl/nisnote.jsp](http://www.hcup-us.ahrq.gov/db/vars/zipinc_qrtl/nisnote.jsp)
§All rural hospitals are classified as non-teaching as per [https://www.hcup-us.ahrq.gov/db/vars/nis_stratum/nisnote.jsp](https://www.hcup-us.ahrq.gov/db/vars/nis_stratum/nisnote.jsp)
¶For 2012-2014, NIS data includes divisions instead of regions. However, the 9 divisions in the data were grouped into regions as per [https://www.hcup-us.ahrq.gov/db/vars/nis_stratum/nisnote.jsp](https://www.hcup-us.ahrq.gov/db/vars/nis_stratum/nisnote.jsp)